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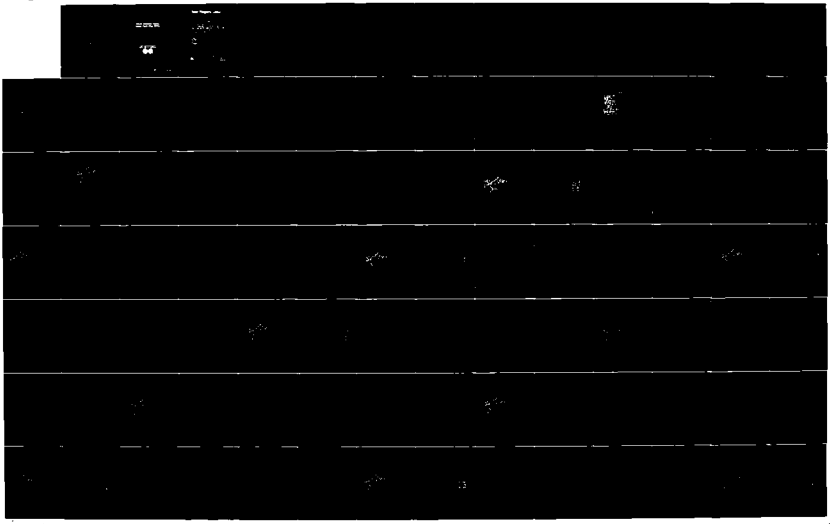

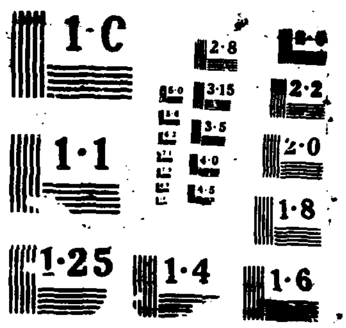
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NWC TP 6828

Naval Weapons Center Active Fault Map Series

by
G. R. Roquemore
and
J. T. Zellmer
Research Department

AUGUST 1987

NAVAL WEAPONS CENTER
CHINA LAKE, CA 93555-6001

Naval Weapons Center

FOREWORD

This report describes the results of nearly 10 years of effort to map and better understand the active faults, that is, faults that have moved during about the last 10,000 years, within NWC and the surrounding areas. The maps show, with a high degree of reliability, the locations of fault scarps and other geomorphic expressions of active faults. The mapping and descriptive annotations will be of use to planners, engineers, scientists, and others interested in the locations of faults and the potential for seismic activity.

This report describes work performed over the period 1979 through 1987. Work was funded by Management Support Items.

This report has been reviewed for technical accuracy by Dr. P. St. Amand.

Approved by
R. L. DERR, *Head*
Research Department
31 August 1987

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The NWC Active Fault Map Series shows the locations of active faults and features indicative of active faulting within much of Indian Wells Valley and portions of the Randsburg Wash/Mojave "B" test range areas of the Naval Weapons Center. Map annotations are used extensively to identify criteria employed in identifying the fault offsets, and to present other valuable data. All of the mapped faults show evidence of having moved during about the last 12,500 years or represent geologically young faults that occur within seismic gaps. Only faults that offset the surface or show other evidence of surface deformation were mapped. A portion of the City of Ridgecrest is recommended as being a Seismic Hazard Special Studies Zone in which detailed earthquake hazard studies should be required.

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CONTENTS

INTRODUCTION

The maps that comprise the NWC Active Fault Map Series include much of Indian Wells Valley (IWV) and a large portion of the Randsburg Wash/Mojave "B" test range area of the Naval Weapons Center (Figure 1). Mapping within Indian Wells Valley included seven complete 7-1/2 minute quadrangles and sections of four additional quadrangles for a total of over 1400 km^2. Mapping within the Randsburg Wash/Mojave "B" test ranges included five complete 7-1/2 minute quadrangles, largely along the Garlock fault, and totaled nearly 800 km^2. These annotated maps show the locations and morphology of the active faults identified within the study area. The annotations and map symbols describe features indicative of fault offsets or give characteristics of the fault's history, such as the scarp angle or number of earthquakes. For several locations the features suggestive of fault activity or of slope instability are indicated.

The following sections describe the mapping process, criteria used in evaluating the faults, descriptions of the major active fault zones and discussions of various seismic hazards. Also included is the recommendation that a seismic hazard special studies zone be established along the trace of the Little Lake fault zone, within the City of Ridgecrest.

ACTIVE FAULT DEFINITION

Although it is a commonly used term, "active fault" lacks a precise and universally accepted definition. Most workers, however, accept the following:

> "Active fault - a fault along which there is recurrent movement, which is usually indicated by small, periodic displacements or seismic activity" (Reference 1).

Slemmons and McKinney (Reference 2) expand on this bask definition and include several characteristics of active faults:

> "An active fault is a fault that has slipped during the present seismotectonic regime and is therefore likely to have renewed displacement in the future. The fault activity may be indicated by historic, geologic, seismologic, geodetic, or other geophysical evidence of activity. The rates of activity may vary from very low, with long recurrence intervals, to very high, with short recurrence intervals."

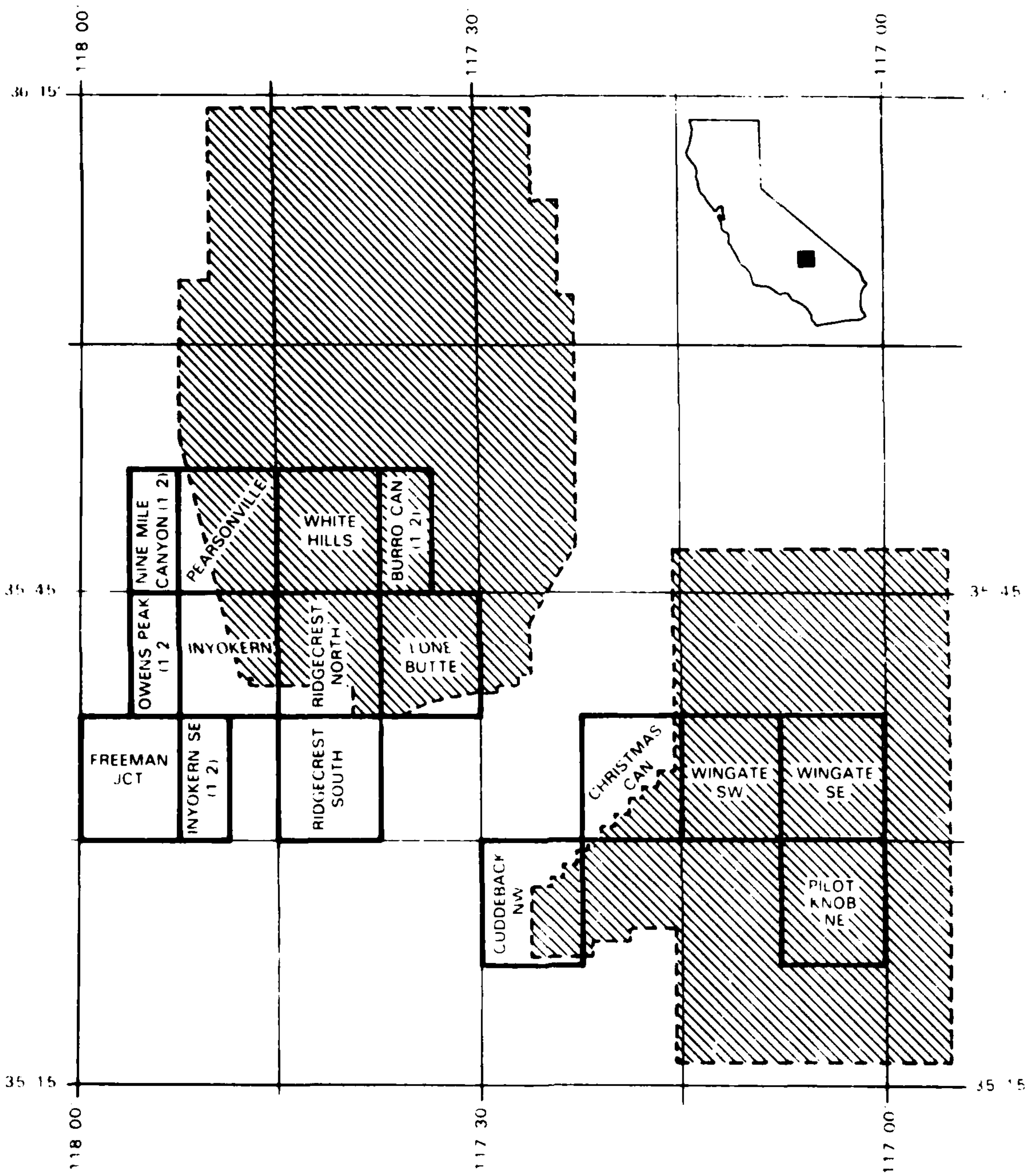

FIGURE 1. Locations of Mapped Quadrangles. Cross-hatched regions are NWC range areas.

In addition to the above, current usage generally requires that a time factor be included. Most agree that any demonstrable movement during the Holocene Epoch, approximately the last 10,000 years, qualifies the fault as "active." For this study we use 12,500 years, which corresponds to the most recent high level of pluvial Lake China. Depositional and erosional features of this and much more recent; lower lake levels occur within Indian Wells Valley and provide useful age constraints.

Some mapped offsets along the Sierra Nevada may predate 12,500 years. However, this segment of the fault zone has been designated as a "seismic gap" (References 3 and 4) which justifies conservatism in earthquake hazard assessment. Seismic gaps are segments of fault zones that have not experienced a significant earthquake during the time that most of the other segments of the zone have. Thus, seismic gaps are thought to have a high potential for future earthquakes and have been found useful in predicting earthquakes.

ACTIVE FAULT MAPPING AND DATA ACQUISITION

Preparation of the NWC Active Fault Map Series spanned nearly 10 years. During this time, we obtained and analyzed about 1,500 new aerial photographs, conducted aerial reconnaissance, acquired special purpose aerial photography along critical fault zones, excavated and logged several trenches across active faults, surveyed and profiled numerous fault scarps, conducted seismic surveys, and carried out field studies to verify the correctness of our data and interpretations and to obtain additional data.

We produced initial fault maps using stereographic pairs of low-sun-angle, color, aerial photographs at a scale of 1:12,000 in the manner of Cluff and Slemmons (Reference 5). These photographs were taken early in the morning or late in the afternoon when the sun was less than about 20 degrees above the horizon. The low sun-angle accentuates fault traces by casting shadows across the fault scarp or by highlighting it. Many of the faults mapped from these photographs are difficult, if not impossible, to recognize on existing black and white, small scale, high-sun-angle photographs because of the subtle topographic and geomorphic expression and the subdued contrast of the desert sand and other surficial deposits. The photographs were useful in identifying topographic and geomorphic features that are commonly associated with active faults. Most of the features are shown in the block diagram at the lower left corner of each map.

In addition to the color aerial photographs, we obtained low-altitude, large-scale, black and white, stereographic photographs along certain critical zones, such as the segment of the Little Lake fault responsible for the 1 October 1982, M=5.2 (recently downgraded to M=4.8) earthquake. The available photographic coverage was supplemented with color slides, and color and black and white photographs taken from both aircraft and on the ground with hand-held cameras. Existing black and white aerial mapping photographs with scales ranging from 1:34,000 to 1:47,200 were also used extensively.

Trenches were excavated across several faults to determine the displacement history of the fault and to collect datable materials such as carbon for radiometric dating (Reference 6). The trenches which were about 4 m wide and ranged from 3 to 5 m in depth and from 30 to 50 m in length. In one particularly important trench in which the walls tended to collapse, we photographed the walls with a large-format camera to obtain stereographic coverage for later analysis. Trench locations are indicated on some of the maps.

We surveyed and constructed topographic profiles for numerous fault scarps that displayed evidence of multiple offsets. A slope formed by faulting and subsequent erosion is often composed of two or more segments, or bevels that are useful in estimating the age of the earthquakes, the amounts of offset, and their magnitudes. The bevel angle and height can be directly measured in the field or from topographic profiles of the fault scarp obtained by surveying. The locations and data obtained from these surveys are shown on the maps.

The mapping project involved considerable field work and ground verification. This consisted of examining the fault scarps and adjacent areas to determine the characteristics of the mapped or suspected offsets. The field work provided data such as fault-scarp profiles, displacement measurements, analyses of small-scale geologic structures, sample collection, field measurements, and detailed mapping that could not be obtained by other means. During the field work we added several previously unrecognized active faults and eliminated several fault-like features that could be attributed to other causes.

DETERMINATION OF FAULT AGE

Determining the age of prehistoric fault offsets is frequently a difficult task based upon the synthesis of numerous bits of data from several, sometimes independent sources. The age-determination techniques used during this study include structural and stratigraphic relationships, soil development, trenching data, tephrachronology, radiometric dating, fault-scarp profiling, and geomorphology. Using these techniques, we were able to estimate or at least bracket the ages of movement along many of the faults within the study area and thereby classify them as either active or inactive.

A basic tenet of geology states that any structure, for example a fault, that cuts across a stratigraphic unit is younger than that stratigraphic unit. Thus, by determining the age of the stratigraphic unit we can assign a maximum age for the fault offset. Within the mapped region, many of the faults cut across sediments (stratigraphic units) deposited in ancient Lake China and Lake Searles. These lakes filled completely and overflowed into lower basins between about 12,500 and 10,000 years ago (Reference 7). Climatic changes then caused the disappearance of the lakes until between about 6,000 and 2,500 years ago when they were partially refilled. The sediments deposited in the lakes during these two periods provide datums for estimating the ages of the faults that offset them. Other datable stratigraphic units such as deposits of airborne volcanic materials (tephra) and ancient soils (paleosols) can also be used for this purpose.

Tephra and paleosols are found within the study area. The tephra deposits are often associated with volcanic eruptions that have been dated by radiometric methods. Although found at some distance from their sources in the Coso Range and elsewhere they generally provide reliable age control markers. The age dating of paleosols is not as reliable or straightforward as it is for tephra and involves assessing the degree of soil development. Because numerous factors affect the rate and characteristics of soil development only a minimum, maximum, or broad range can generally be estimated for the age of most paleosols. Despite the difficulties encountered, both paleosols and tephra often prove useful in fault movement age determinations.

Often, datable materials or stratigraphic units with known ages are not found at the surface and it becomes necessary to dig an exploration across the fault. The trench walls often reveal the fault plane, offset stratigraphic units and younger non-offset stratigraphic units. Figure 2 shows as example of how these features might appear in a trench. Of special interest to the geologist is the progressively greater increase in offset with age. This indicates that more than one earthquake has occurred along the fault since the oldest sediments were deposited.

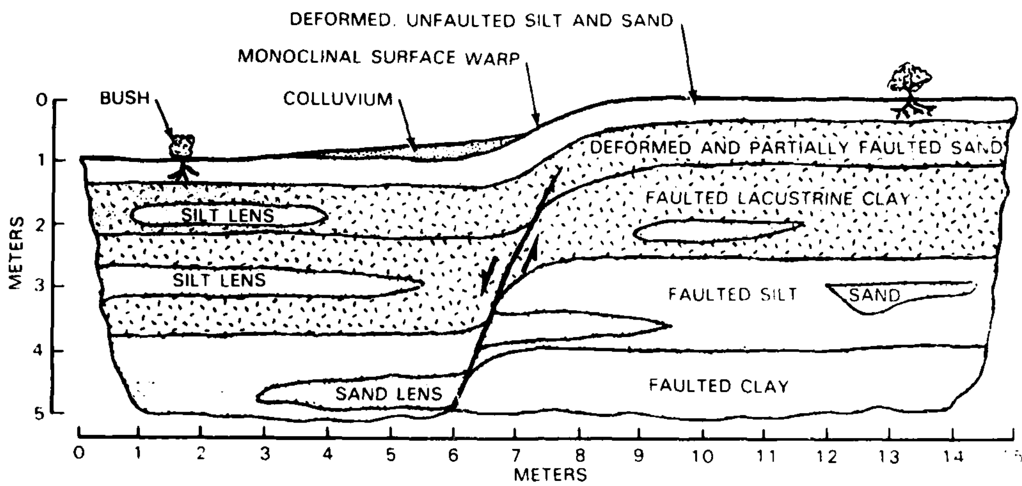

FIGURE 2. Features Typically Observed in Walls of Trenches Excavated Across Active Faults. The ages of the sediments increase with depth.

The number of bevels that comprise a fault scarp and the steepness of the bevels can be used to determine the number and ages of the earthquakes that formed the scarp (Reference 8). Figure 3, an example of a fault scarp profile, shows the youngest bevel, which corresponds to the actual fault plane; an older, shallower-dipping intermediate bevel; the oldest and shallowest dipping bevels; and the original offset ground surface. The bevels indicate that three earthquakes formed the fault scarp and that there was sufficient time between the earthquakes for the original, steep fault scarp bevel to erode to a shallower angle prior to the subsequent earthquake. If we can determine the rate of bevel erosion, it is possible to correlate the bevel angle with the age of the bevel. The age/angle correlation problem is difficult to solve, but can provide reasonable estimates for the ages of earthquakes, and at a minimum, provides valuable information about the recurrence characteristics of earthquakes associated with a particular fault.

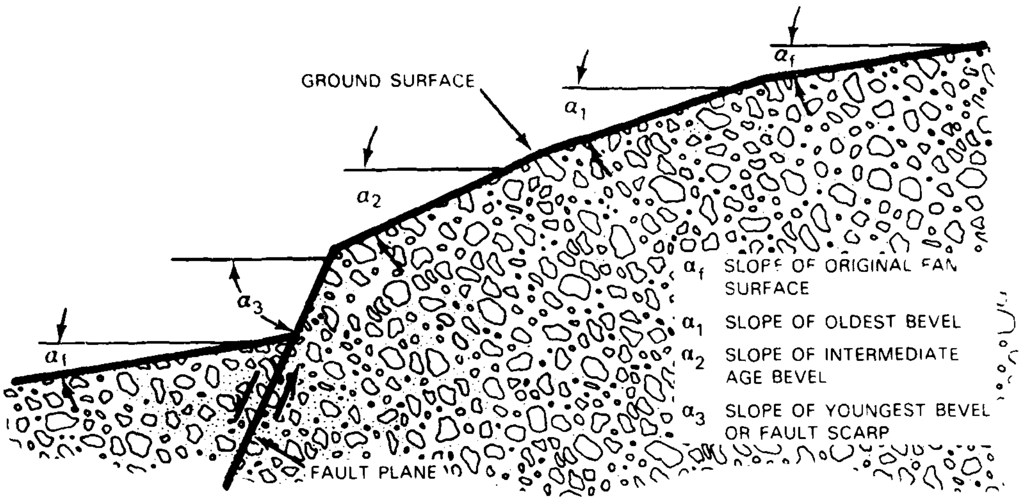

FIGURE 3. Topographic Profile and Hypothetical Cross Section Across an Active Fault Showing the Development of Erosional Bevels.

Geomorphic (landform) criteria such as that described above are useful in estimating the ages or relative ages of fault scarps (Reference 9). Typical fault-related geomorphic features are shown in the block diagram on each map sheet. In practice, subjective judgments of the ages of the features must be amde. Young, fault-related geomorphic features tend to be sharp and angular whereas older features become more rounded and subdued. The fault scarp bevels shown in Figure 3 are an example of this phenomenon. Although they do not yield definitive ages, geomorphic features help the geologist determine the number of earthquakes that have occurred, their ages, and amounts of displacement. Data such as these are used in reconstructing the earthquake history of the fault which is used as an indicator of future seismic activity.

MAJOR ACTIVE FAULTS IN THE REGION

Four major active faults present a direct hazard to development within the mapped area: the Little Lake (LLFZ), the Airport Lake (ALFZ), the Sierra Nevada (SNFZ), and the Garlock (GFZ) fault zones. Figure 4 shows these fault zones relative to the other major active faults in the region. The LLFZ strikes southeast across IWV from its intersection with the SNFZ near Little Lake and based on seismicity data, appears to terminate against the Garlock fault. The maximum credible earthquake for the right-slip to right-oblique-slip LLFZ could conceivably exceed M=8 if simultaneous rupture along the SNFZ occurs. However, work by Roquemore (Reference 5) and a preliminary analysis by the U.S. Geological Survey indicate that M=6.5 is more appropriate for earthquakes involving only the LLFZ. Data obtained since 1938 suggest that earthquakes of about M=5 with a recurrence period of 20 years could be considered as "characteristic earthquakes" (Reference 10) for the fault. Seismological studies of the LLFZ (Reference 11) indicate that the fault dips steeply northeast and, therefore, earthquake epicenters are displaced northeast of the mapped fault trace. As a result, much of Ridgecrest and NWC are located within the expected epicentral zone for future, damaging earthquakes. The southern segment of the LLFZ is also referred to as the Shangri La Ranch fault.

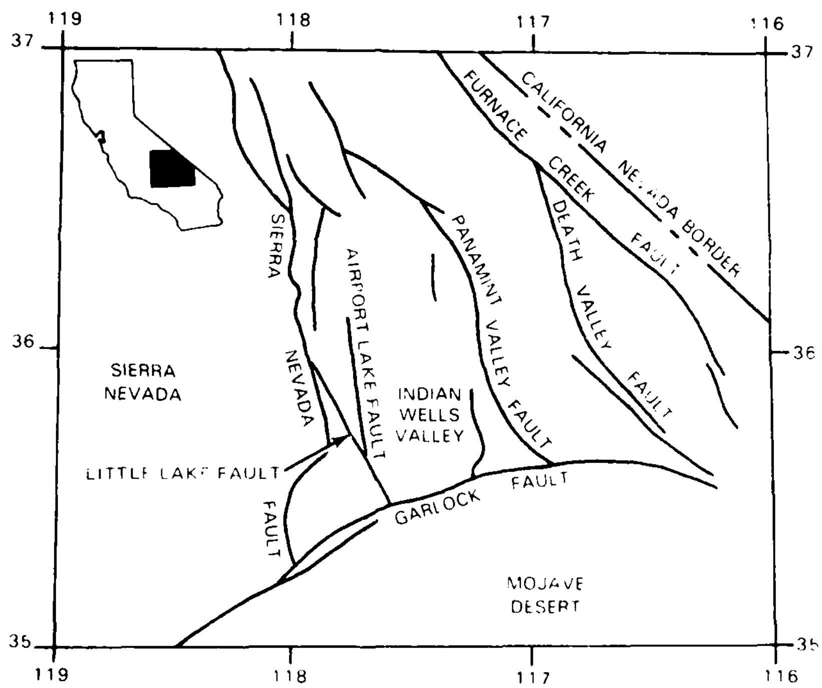

Figure 4. Locations of Important Active Faults in the NWC Region.

The ALFZ strikes north-south through the Coso Range, into IWV and terminates against the LLFZ in the Armitage Field area. The fault zone is a system of nested grabens that range in width from 0.5 to 8 km. The maximum vertical offset is 600 m. Because of its structural characteristics and close association with volcanic activity, Roquemore (Reference 12) describes the ALFZ as a possible rift valley that could be responsible for future volcanic and seismic activity. Trenching studies by Roquemore (Reference 6) suggest that the zone may be capable of M=7.4 earthquakes. Several swarms with earthquakes exceeding M=4 have occurred along the fault in the Airport Lake area during the last several years (see for example Reference 13). South of Airport Lake, within the zone of intersection between the ALFZ and LLFZ, five earthquake swarms with over 1000 earthquakes occurred during 1981-1983, including the 1 October 1982, M=4.8 shock (References 11, and 13 through 16). Within IWV it appears that the regional east-west extensional stresses and northwest-southeast shear stresses are being accommodated by displacements along the LLFZ and ALFZ.

The SNFZ is a major range-bounding fault that separates IWV and the Sierra Nevada and extends for several hundred kilometers along the east side of the range. The fault has generally been considered as the western edga of the transition zone separating the right-slip tectonics of the San Andreas fualt system from the exentional tectonics of the Basin and Range Province. However, work during the last several years (References 17 through 19) suggests that regional extension is migrating westward into the Sierra Nevada. Normal and right-normal-oblique-slip faulting that accommodates northwest-southeast regional shear and east-west regional extension has been documented at several locations along the Sierra Nevada fault (References 20 and 21). Savage et al. (Reference 22) report 4 mm/yr of right-slip parallel to the fault and about 1 mm/yr of extension normal to it, based on geodetic surveys in Owens Valley, thus confirming right-normal-oblique-slip strains.

One of the largest earthquakes that has occurred in the Western United States is often, and incorrectly, attributed to the SNFZ. This was the 1872, $M \geq 8.25$, Lone Pine, Calfiornia, earthquake (Reference 23) that occurred along the Owens Valley fault, slightly east of and subparallel to the SNFZ. These two faults merge into a single zone near Big Pine on the north and Owens Lake on the south and therefore should probably be considered as segments of the same regional fault. These, and other data, prompted Wallace (References 3 and 4) to classify the segment of the SNFZ south of the 1872 rupture zone as a seismic gap capable of a M=7.0 earthquake. This segment of the SNFZ includes the west border of IWV. Although the faults mapped along this segment have not been shown to have moved during the last 10,000 yr, their youthful appearance and designation as a seismic gap should qualify them as "active" for planning purposes.

The GFZ is one of the longest active faults in California and forms the boundary between the extensional tectonics of the Basin and Range province to the north and the relatively more stable Mojave

Desert province to the south. Numerous studies have shown that the GFZ is a major active left-slip fault, the western segment of which is slipping at a rate of about 7 mm/yr, and the eastern segment of which appears to be temporarily locked. Astiz and Allen (Reference 24) summarize much of what is known about the seismology and tectonics of the fault. As a result of their study, they conclude that the eastern segment of the GFZ, that is, the segment approximately between the Garlock townsite and Death Valley, is a seismic gap capable of producing earthquakes in the M=7.6 to 8.0 range.

The four active fault zones discussed above are capable of producing moderate to great earthquakes. Each fault passes beneath or near population centers, important facilities, utility corridors and transportation routes. Active faults of lesser importance also occur throughout the mapped area. The potential hazards associated with active faults in this region should be adequately incorporated into any future development or planning.

RECOMMENDED SEISMIC HAZARD SPECIAL STUDIES ZONE

Several factors, most notably ground-surface disruption by cultural activities, prevented detailed mapping of the Little Lake (Shangri La) fault zone in the Ridgecrest area. Because of the potentially serious earthquake hazard, we have designated a portion of this area as a Recommended Seismic Hazard Special Studies Zone. At least three earthquakes with magnitudes of about M=5 have occurred on the Little Lake fault during the last 49 years: 1938, 1961, and 1982. Of these, only the 1982 M=4.8 event received detailed study (References 14 and 15). The epicenter of this earthquake was 14 km northwest of the Ridgecrest City Hall and occurred within a sparsely developed area of the NWC test ranges. The earthquake ruptured the ground surface over a distance of 10 km and was associated with numerous lesser magnitude aftershocks. Reported damage was minor due to the distance between the epicenter and population centers. Had the epicenter been further south, for example, within Ridgecrest, serious damage and injuries could have occurred.

Standard construction and siting practices designed for use in seismically active areas can greatly reduce the hazard to life and property. These practices depend on the proximity of the structure to the fault; and, therefore, the locations of any faults should be determined prior to construction so that the proper design and setback criteria can be incorporated. In addition, one should be aware of other factors such as potentially liquefiable materials, high ground-water tables or marginally stable slopes that may affect the structure during an earthquake. Because the locations of the faults within the special studies zone cannot be readily determined from surface expression alone, we recommend that appropriate investigations, for example trenching, drilling or geophysical exploration techniques, be conducted on a site-specific basis prior to final construction approval.

EARTHQUAKE DAMAGE POTENTIAL

The following is a brief discussion of several factors that influence the level of damage that occurs during earthquakes. The list is not all inclusive, only exemplary. Considering factors such as these during the planning, siting, exploration, design and construction phases of any project can result in a holistic solution to the general problems of damage, personal injury and death that will occur as the result of future, damaging earthquakes, both locally and in the region.

The level of damage resulting from an earthquake is influenced by several geologic and geotechnical factors, such as the magnitude of the earthquake, the distance from the epicenter, the depth of the earthquake, the type of fault movement, the type of geologic materials, the depth to ground water at the site, and local topography. The NWC Active Fault Map Series is intended to show the locations of known active faults so that inappropriate development of these areas can be avoided. Active fault zones are ideally suited for greenbelts and various recreational uses, and should be avoided for residential and commercial development; they must absolutely be avoided when constructing lifeline facilities such as hospitals, fire and police stations, utilities, and other facilities that must function during emergencies. One must also recognize that other, unmapped active faults may exist and that faults now considered inactive, and thus not shown on the maps, could rupture during future earthquakes.

Ground Shaking and Building Response

The severity of ground shaking experienced at a site is strongly influenced by the magnitude of the earthquake, the distance from the epicenter and site geology. In general terms, the severity of shaking tends to decrease with decreasing earthquake magnitude and increasing epicentral distance. However, the site geology and type of construction can markedly intensify the arriving seismic energy. It has long been recognized that structures built on bedrock often suffer less damage than those sited on alluvium (Reference 25). The difference results from the manner in which the seismic energy passes through the medium. For bedrock, the energy passes without modification, but for the softer alluvium the seismic wave behaves similarly to a shoaling sea wave, that is, the wave amplitude and wavelength increase. As a result, structures sited on thick alluvium tend to experience larger ground surface displacements and higher accelerations and velocities that can result in more severe structural damage than would occur to similar structures on bedrock. This is especially true of tall buildings built on alluvium.

Another factor that should be considered is the natural frequency of the structure relative to that of the subsurface mass. If the two natural frequencies are similar, for example a ductile five story building with a natural frequency of about 0.5 second, and the alluvium of Indian Wells Valley with an estimated natural frequency of 0.5 second, then there would be a tendency for the structure to resonate during an earthquake and suffer greater damage than if the natural frequencies were dissimilar. Similarly, stiff, brittle structures should be avoided on bedrock, where the natural frequency would usually be higher.

Although structures cannot always be built in perfect harmony with their seismic and geologic environment, the level of damage experienced during an earthquake can be minimized by incorporating the results of a preconstruction geotechnical and geological site investigation and strict adherence to at least the minimum design and construction practices required by the Uniform Building Code for Seismic Zone Four. These are, however, minimum requirements; and higher standards should be used wherever possible, especially when critical facilities, such as lifelines, are involved. Additional protection can be obtained by incorporating modern earthquake engineering concepts such as base isolation and various damping systems.

Liquefaction

Liquefaction refers to the temporary transformation of a soil mass from the solid to liquid state during an earthquake. Because the soil mass may lose the ability to support even itself, liquefaction is responsible for a high percentage of the damage that has occurred during many earthquakes. In general, liquefaction is most likely to occur under the following conditions: (1) the local earthquake has a magnitude of $M \geq 5$, (2) the water table is within 10 m of the surface, and (3) the soil consists of fine grained, poorly-graded, cohesionless material such as silt or fine sand. Typical liquefaction damage includes foundation failures of buildings and bridges, collapsed roads, slope failures and waterfront and shoreline failures. The generalized liquefaction potential for a portion of IWV has been determined by Banks (Reference 26). Detailed studies should be conducted for sites that are located in areas of high to moderate susceptibility as indicated by Banks.

Slope Stability

Seismically induced slope instability is not a major consideration throughout much of the mapped area. The greatest hazard will occur in the adjacent mountainous areas of the Sierra Nevada, Argus and other ranges. Rockfalls, landslides and related road closures should be the most serious problems. These will range from localized to regional in extent depending on earthquake magnitude and location. Slope failure or fault rupture could, however, seriously affect the aqueduct system along the Sierra Nevada.

SUMMARY

The NWC Active Fault Map Series shows the locations of active faults within much of Indian Wells Valley and portions of the Randsburg Wash/Mojave "B" test range areas of NWC. The mapped faults either show evidence of having moved during the last 12,500 years or occur within identified seismic gaps. Only fault traces that extend to the ground surface or show other evidence of surface deformation have been mapped; and, therefore, additional studies, such as trenching, should be conducted prior to developing areas near or along the trend of the mapped faults. This is especially true within the recommended Seismic Hazard Special Studies Zone of Ridgecrest where the fault traces are poorly developed or preserved.

ACKNOWLEDGMENTS

This study was initiated as part of Project 2000. We appreciate the support of Mr. Robert Hillyer (former Technical Director at NWC) and Mr. James Bowen through the course of this project.

Active fault data for the Indian Wells Valley area were also obtained from St. Amand (1958) (Reference 27), von Huene (1960) (Reference 28), Moyle (1963) (Reference 29), and Dutcher and Moyle (1973) (Reference 30).

Mapping of the most recent breaks on the Garlock fault located on the Christmas Canyon Quadrangle was aided by Malcomb Clark's Miscellaneous Geologic Investigation, Map I-741 (Clark, 1973) (Reference 31).

REFERENCES

1. R. L. Bates and J. A. Jackson, editors. Glossary of Geology, 2nd Ed, American Geological Institute, Falls Church, Virginia, 1980.

2. D. B. Slemmons and R. McKinney. Definition of "Active Fault," Miscellaneous Paper, S-77-8, Final Report, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, 1977a.

3. R. E. Wallace. "Patterns of Faulting and Seismic Gaps in the Great Basin Province," U.S. Geological Survey, Open File Report 78-943, 1978, pp. 857-68.

4. R. E. Wallace. "Patterns and Timing of Late Quaternary Faulting in the Great Basin Province and Relation to Some Regional Tectonic Features," Journal of Geophysical Research, Vol. 89, 1984, pp. 5763-70.

5. L. S. Cluff and D. B. Slemmons. "Wasatch Fault Zone-Features Defined by Low-Sun-Angle Photography," Publication 1, Utah Geological Association, Salt Lake City, Utah, 1972, pp. 61-69.

6. Naval Weapons Center. "Active Faults and Associated Tectonic Stress in the Coso Range, California," by G. R. Roquemore. China Lake, Calif., NWC, August 1981, 101 pp. (NWC TP 6270, publication UNCLASSIFIED.)

7. G. L. Smith. "Late Quaternary Geologic and Climatic History of Searles Lake, California," in Means of Correlation of Quaternary Successions, edited by R. B. Morrison and H. E. Wright, Jr., proceedings of the VII INQUA Congress 8:293-310, 1968.

8. R. E. Wallace. "Profiles and Ages of Young Fault Scarps, North-central Nevada," Geological Society of America Bulletin, Vol. 88, No. 9, 1977, pp. 1267-81.

9. D. B. Slemmons. "State-of-the-Art For Assessing Earthquake Hazards in the United States," Miscellaneous Paper S-73-1, Report 6, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, 1977b.

10. D. P. Schwartz and K. J. Coppersmith. "Fault Behavior and Characteristic Earthquakes: Examples From the Wasatch and San Andreas Fault Zones," Journal of Geophysical Research, Vol. 89, No. B7, 1984, pp. 5681-98.

11. A. Bent, C. Johnson, and H. Kanamori. "Indian Wells Valley Earthquake Swarm: 1981-1983," EOS, Transactions, American Geophysical Union, Vol. 67, No. 44, 1986.

12. G. R. Roquemore. "Airport Lake Fault Zone: Possible Rift Valley Formation in the Coso Range, California," Abstracts with Programs, Geological Society of America, Vol. 15, No. 5, 1983.

13. M. C. Walck and R. W. Clayton. "P-Wave Velocity Variations in the Coso Region, California," Derived From Local Earthquake Travel Times, Journal of Geophysical Research, Vol. 92, No. B1, 1987, pp. 393-406.

14. G. R. Roquemore and J. T. Zellmer. "Airport Lake and Little Lake Faults: Ground Cracking Associated With the 1982 Magnitude 5.2 Indian Wells Valley Earthquake," California Geology, September 1983a, pp. 197-200.

15. G. R. Roquemore and J. T. Zellmer. "Tectonics, Seismicity, and Volcanism at the Naval Weapons Center," Naval Research Reviews, Washington, D.C., Vol. XXXV, Three/1983b.

16. C. Sanders, P. Ho-Liv, D. Rinn, and H. Kanamori. "Anomalous Shear-Wave Attenuation in the Shallow Crust Beneath the Coso Region, California," Journal of Geophysical Research (in process).

17. J. P. Lockwood and J. G. Moore. "Regional Deformation of the Sierra Nevada, California, on Conjugate Microfault Sets," Journal of Geophysical Research, Vol. 84, 1979, pp. 6041-49.

18. D. P. Hill, A. S. Ryall, and R. A. Bailey. "Active Tectonic and Magmatic Processes Beneath Long Valley Caldera, Eastern California," in Proceeding of Workshop XIX: Active Tectonic and Magmatic Processes Beneath Long Valley Caldera, Eastern California, U.S. Geological Survey, Open File Report 84-939, 1984.

19. L. M. Jones, and R. S. Dollar. "Evidence of Basin and Range Extensional Tectonics in the Sierra Nevada: the Durwood Meadows Swarm, Tulare County, California (1983-1984)," Bulletin of the Seismological Society of America, Vol. 76, No. 2, 1986, pp. 439-61.

20. D. B. Slemmons. "A Field Guide to Cenozoic Deformation Along the Sierra Nevada Province and Basin and Range Province Boundary," California Geology, May 1975, pp. 99-119.

21. L. Lubetkin and M. M. Clark. "Late Quaternary Activity Along the Lone Pine Fault, Eastern California," in Proceedings of Workshop XXVIII on the Borah Peak, Idaho, Earthquake, U.S. Geological Survey, Open File Report, 85-290, 1985, pp. 118-140.

22. J. C. Savage, J. P. Church, and W. H. Prescott. "Geodetic Measurement of Deformation in Owens Valley, California," Seismological Society of America Bulletin, Vol. 65, 1975, pp. 865-74.

23. G. B. Oakshott, R. W. Greensfelder, and J. E. Kahle. "One Hundred Years Later," California Geology, 1972, pp. 55-61.

24. L. Astiz and C. R. Allen. "Seismicity of the Garlock Fault, California," Bulletin of the Seismological Society of America, Vol. 73, No. 6, 1983, pp. 1721-14.

25. G. W. Housner. "Strong Ground Motion" in Earthquake Engineering, R. L. Wiegel, ed., Prentice-Hall, 1970, pp. 518.

26. Naval Weapons Center. "Soil Liquefaction Potential at the Naval Weapons Center, China Lake, CA," by E. W. Banks, China Lake, Calif., NWC, September 1982. (NWC TP 6392, publication UNCLASSIFIED.)

27. P. St. Amand. "Circum-Pacific Orogeny," Publication of the Dominion Observatory, Vol. 20, No. 2, 1958, pp. 403-411.

28. R. W. von Huene. "Structural Geology and Gravimetry of Indian Wells Valley, Southeastern California (Ph.D. thesis) Los Angeles, California, University of California, 1960, 138 pp.

29. W. R. Moyle, Jr. "Data on Water Wells in Indian Wells Valley Area, Inyou, Kern, and San Bernardino Counties, California," Bulletin No. 91-9, State of California, Department of Water Resources, 1963, 243 pp.

30. L. C. Dutcher and W. R. Moyle, Jr. "Geologic Hydrologic Features of the Indian Wells Valley, California," U.S. Geological Survey, Water Supply Paper 2007, 1973, 30 pp.

31. M. Clark. "Malcomb Clark's Miscellaneous Geologic Investigation," MAP I-741, 1973.

ERRATA SHEET FOR MAPS

Pearsonville Quadrangle Map

- Allignment should be Alignment
- Nothern should be Northern
- 1 Oct 1985 should be 1 Oct 82

Inyokern Southeast Quadrangle Map

- Vegitation should be Vegetation
- Vegatation should be Vegetation
- Allignment should be Alignment
- groundwater should be ground-water

Ridgecrest North Quadrangle Map

- STUDES ZONE should be STUDIES ZONE
- actively-occurring should be actively occurring
- 1 Oct 85 should be 1 Oct 82

Ridgecrest South Quadrangle Map

- Fault trace in the northwest corner is mislocated approximately 800 feet northeast of its true location.

Christmas Canyon Quadrangle Map

- allignment should be alignment
- Liner trench should be Linear trench

Windgate Quadrangle - SW Map

- alluviu should be alluvium

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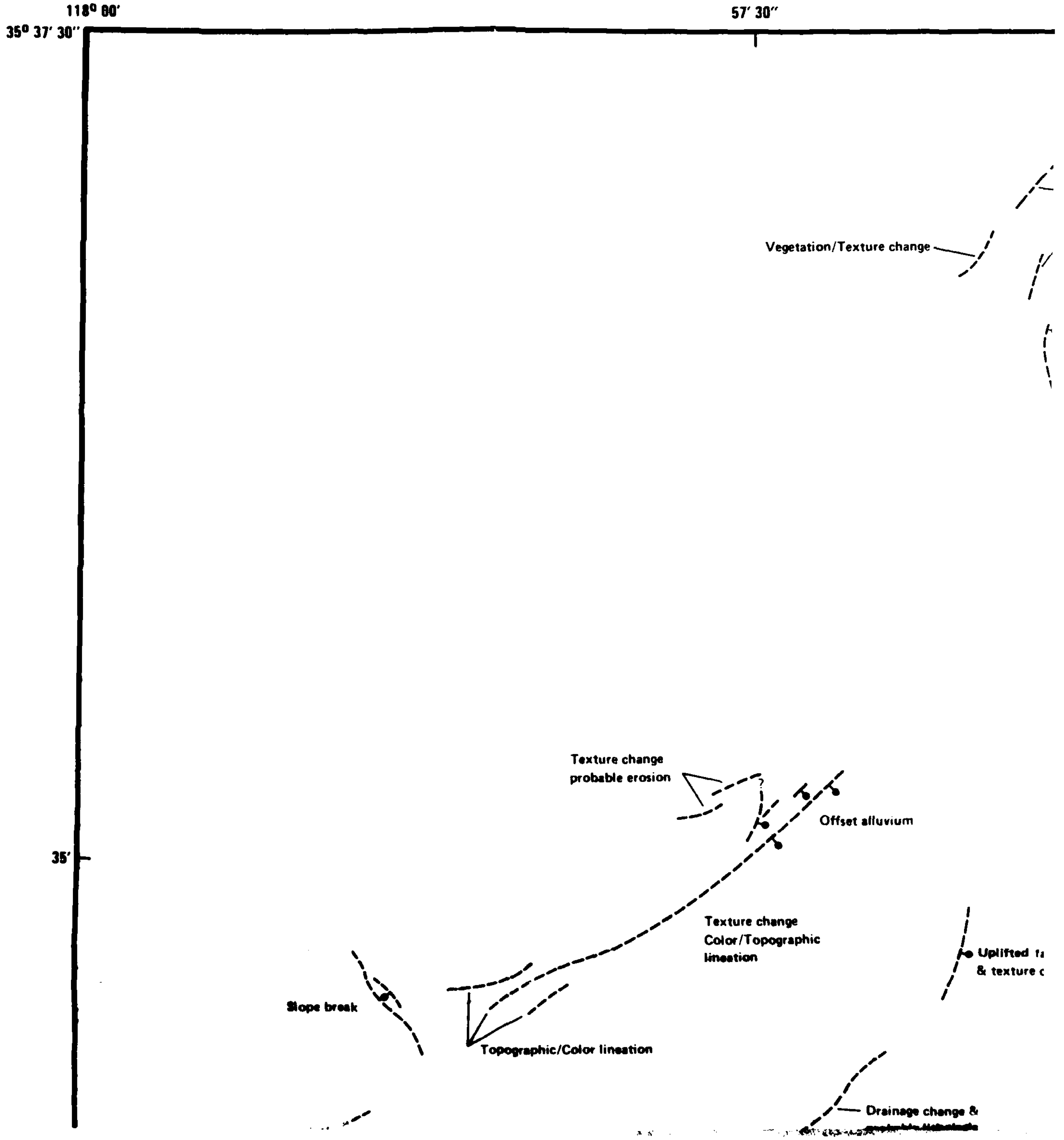
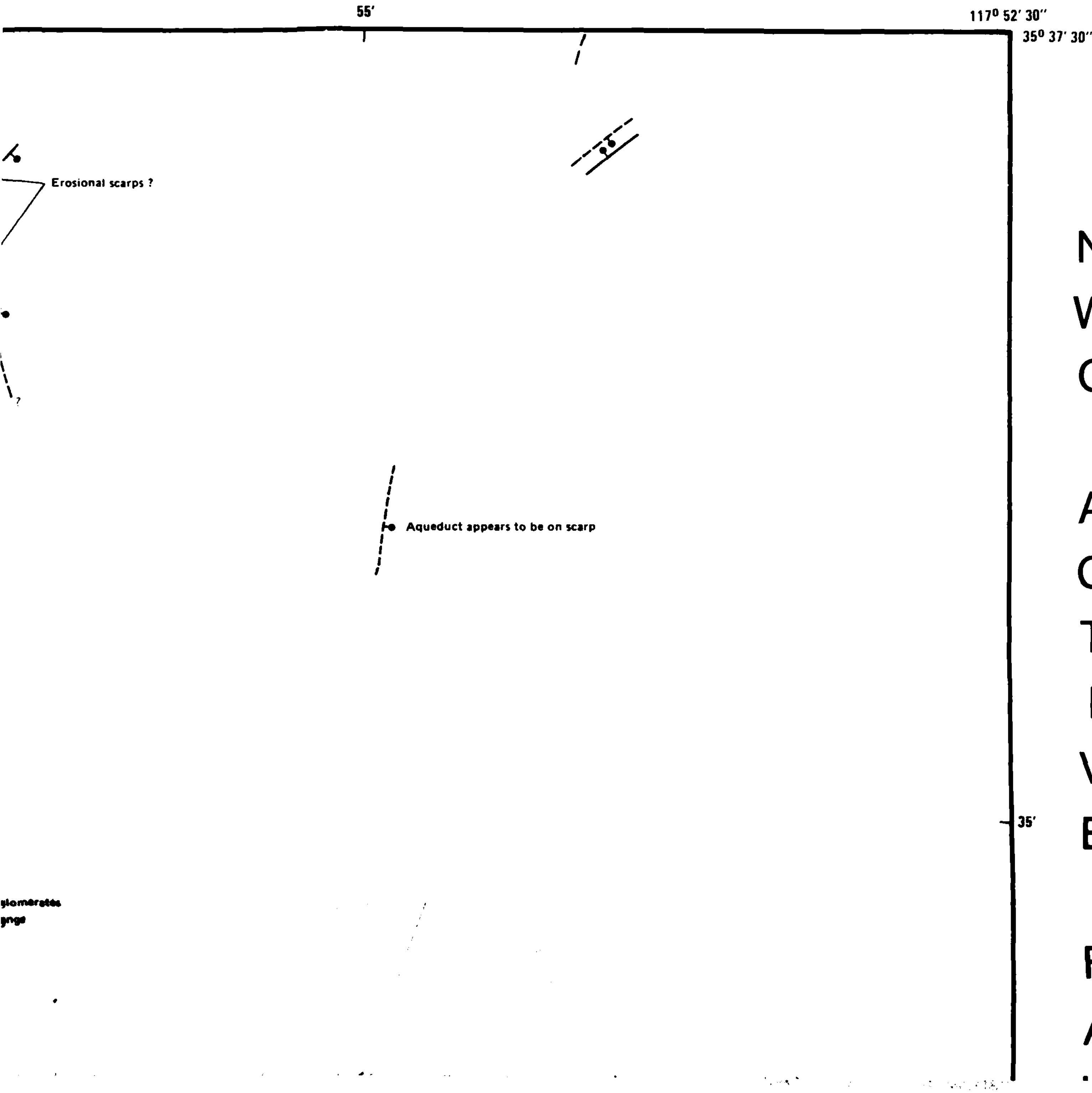


118° 60′
57′ 30″
35° 37′ 30″
Vegetation/Texture change
Texture change
probable erosion
Offset alluvium
35′
Texture change
Color/Topographic
lineation
Uplifted
& texture
Slope break
Topographic/Color lineation
Drainage change &

FREEMAN JUNCTION QUADRANGLE
CALIFORNIA – KERN CO.



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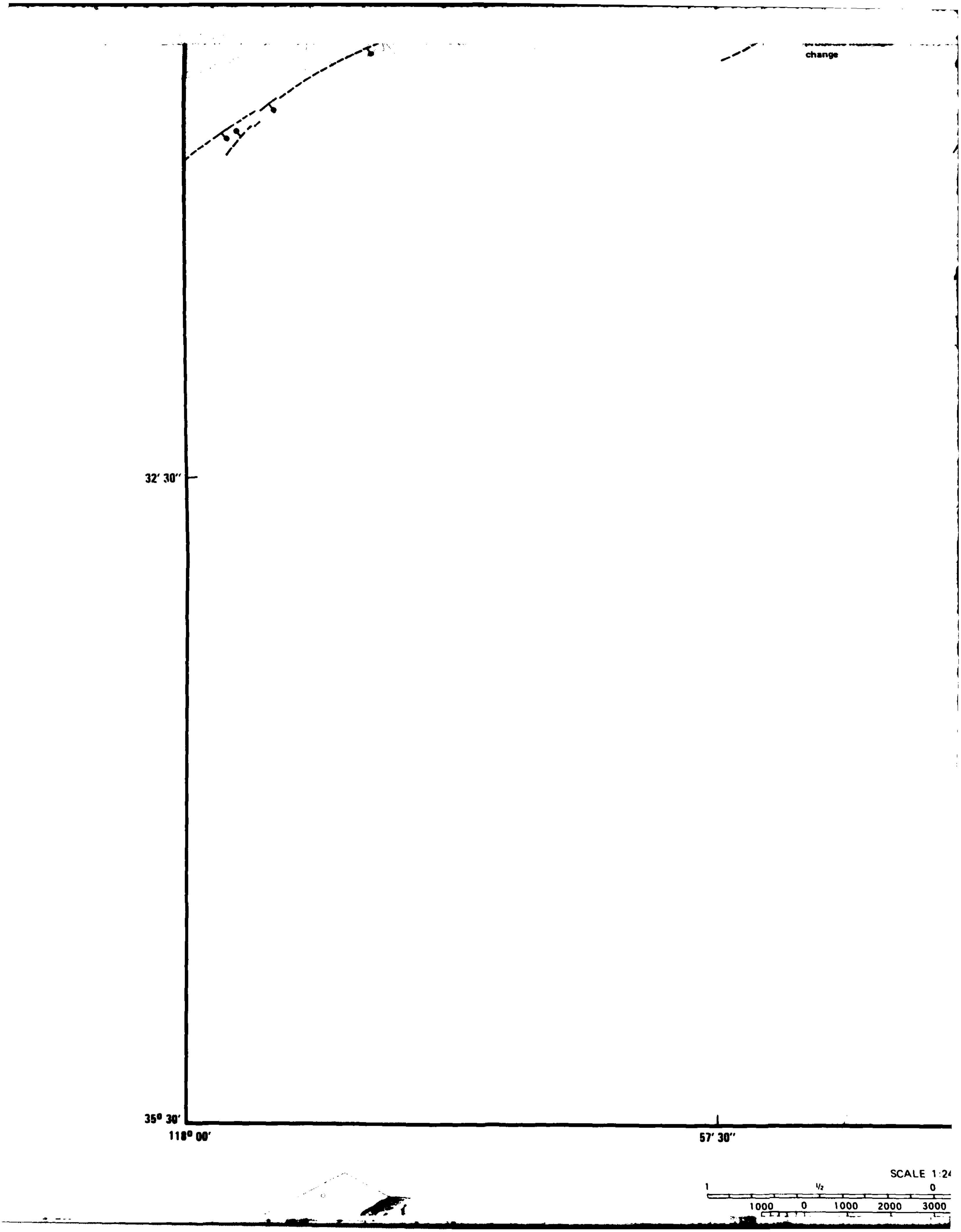

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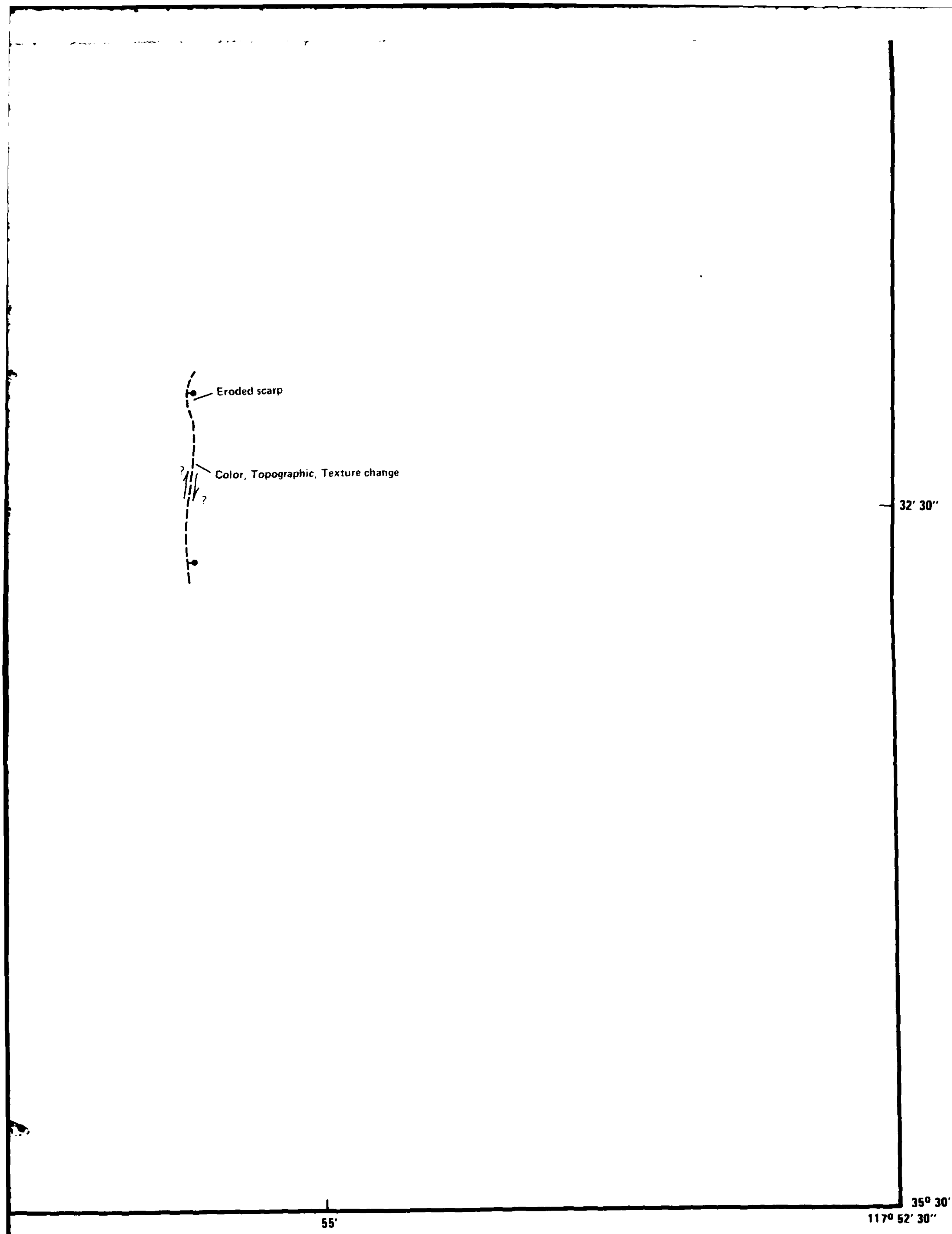

ULT MAP SERIES

BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

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57′ 30″

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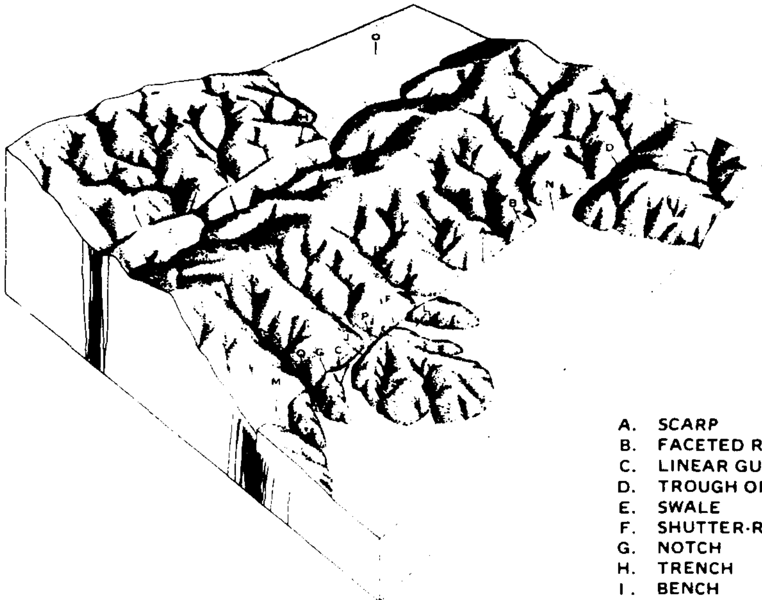


GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

Solid line, field or
scarps, trenches,
scars where note
interpretations not
distinctive surficial
active fault trace
regarded as appro
of relative motion

Other recently ac
features may be p

[1] The brief notes along th
clear. Fault trace features
the mapped fault lines

35° 30′

55′

117° 52′ 30″

:24 000

1 MILE

20 ... 4000 5000 6000 7000 FEET

1 KILOMETER

BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

NTO RVALS, 20 FEET
ATU N SEA LEVEL
APH FROM U.S. GEOGRAPHIC
FRE UNCTION, CALIFORNIA
DRA 72
TOG BY P. O'DELL

EX ATION

— — — — — — — •••••

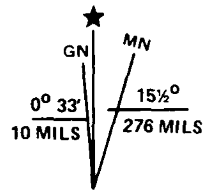
ace

geolo ce of recent movement shown by
nds urface features,[1] including landslide
rred sible recent fault scarp, but other
ded e probable recent movement, but
es of not present; dotted line, potentially
aled ecent alluvium (position should be
bal thrown side; arrows show direction

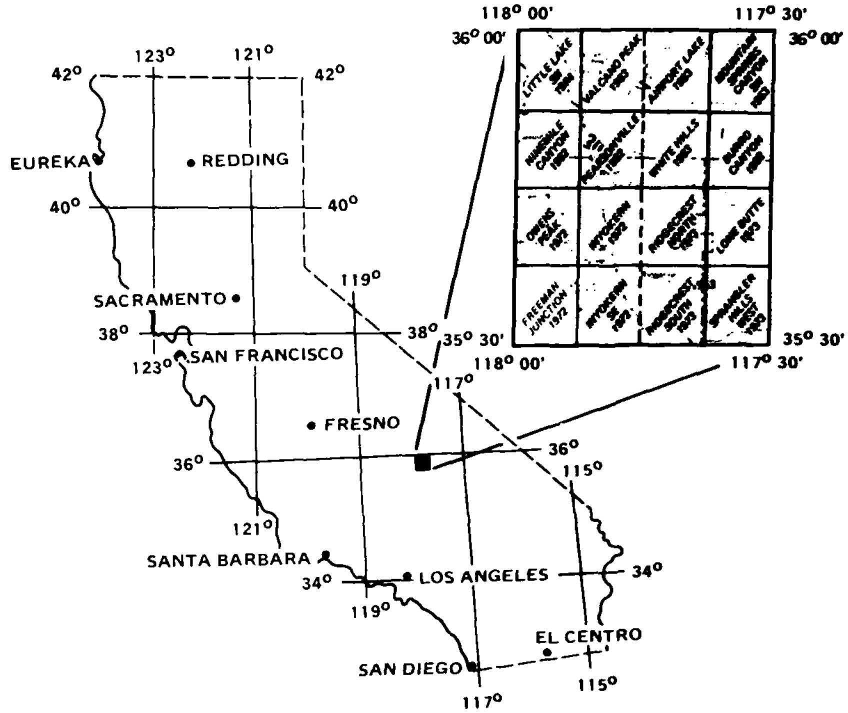
eaks e not produced distinctive surficial

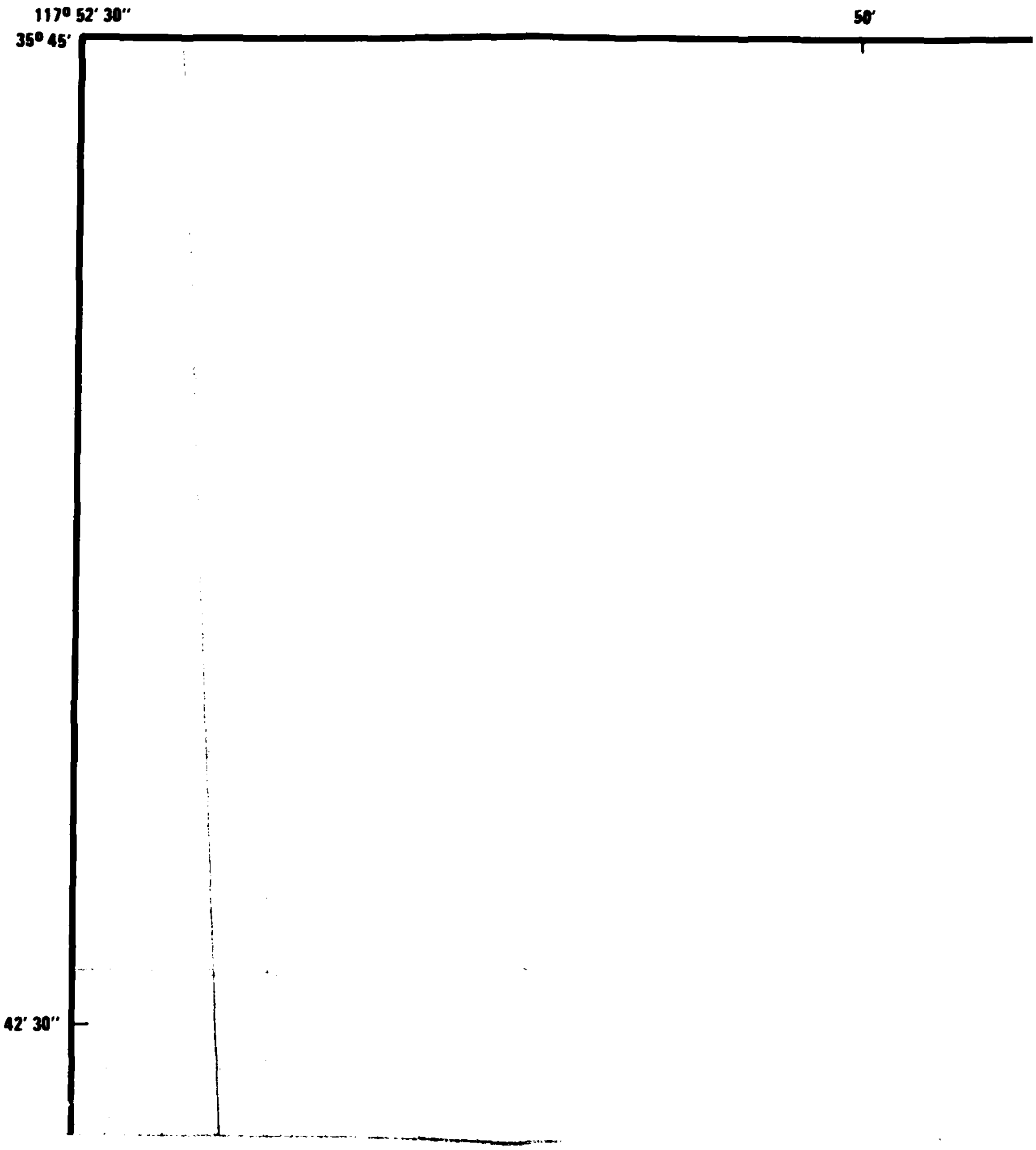
ons where the features mentioned are especially
ities but are present, to some degree, all along

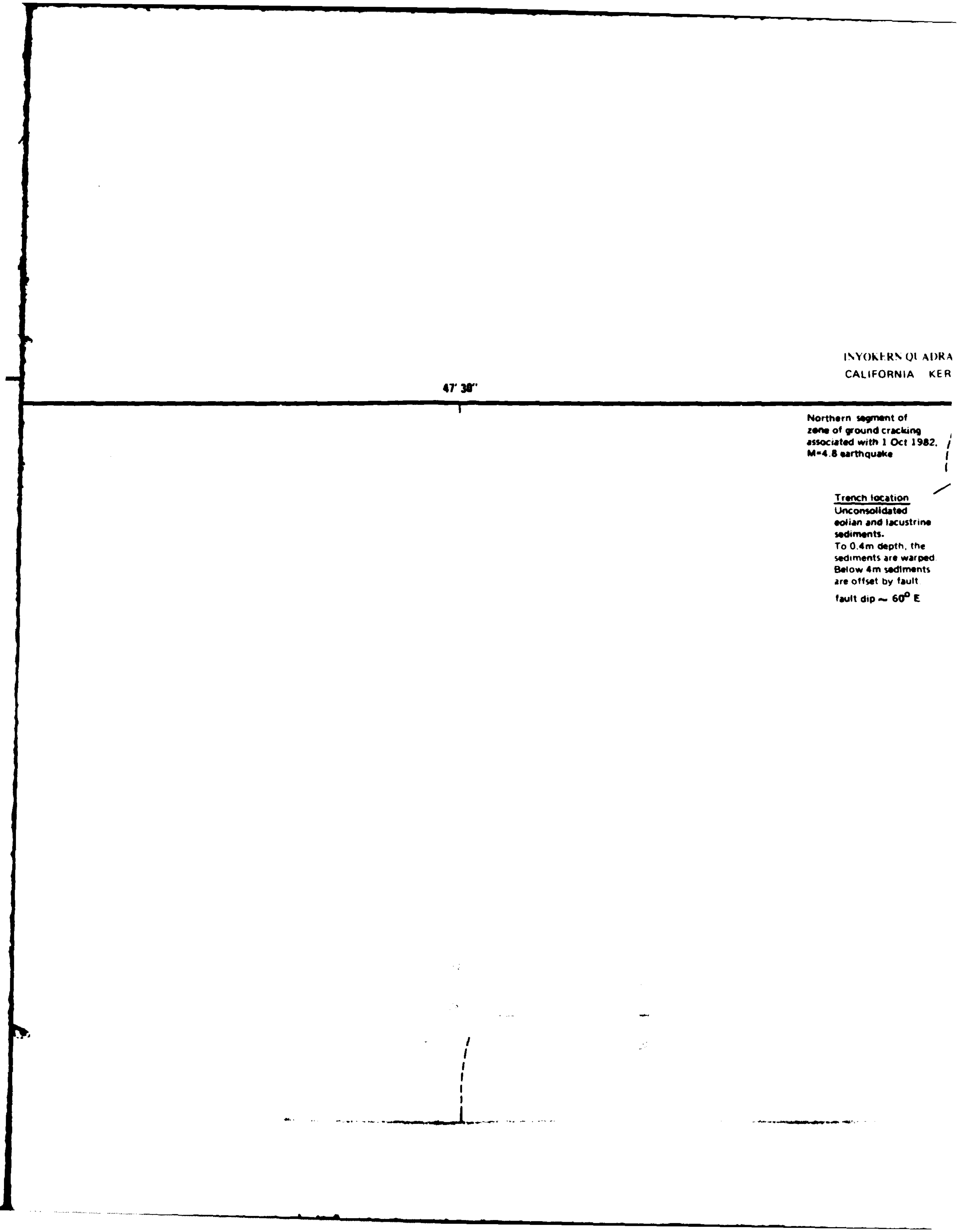
stoc ke Shoreline

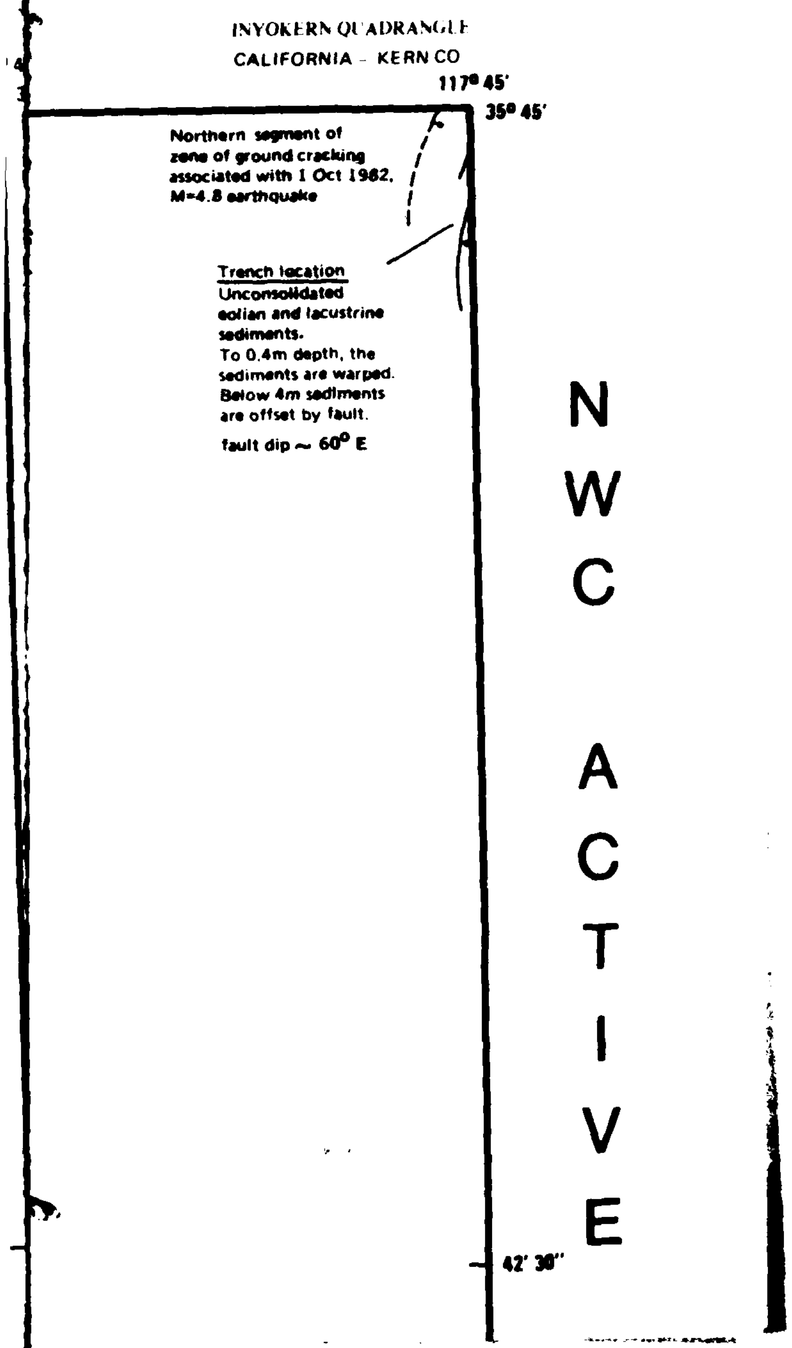


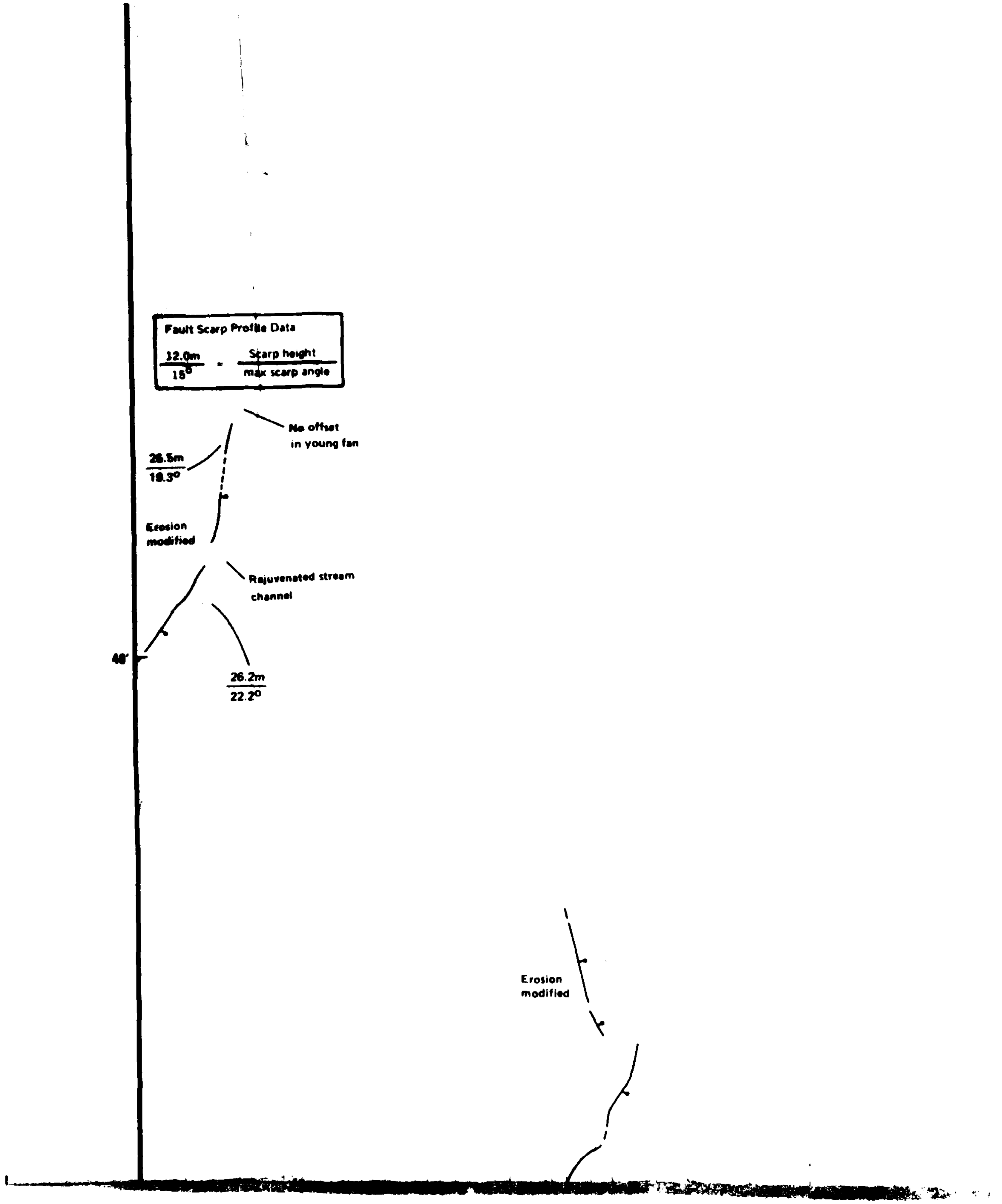
UTM GRID & 1972 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



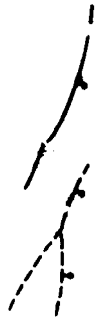

117° 52' 30"
50'
35° 45'
42' 30"


INYOKERN QUADRA
CALIFORNIA KER
47' 30"
Northern segment of zone of ground cracking associated with 1 Oct 1982, M=4.8 earthquake
Trench location
Unconsolidated eolian and lacustrine sediments.
To 0.4m depth, the sediments are warped.
Below 4m sediments are offset by fault
fault dip ~ 60° E


INYOKERN QUADRANGLE
CALIFORNIA - KERN CO
117° 45'
35° 45'
Northern segment of zone of ground cracking associated with 1 Oct 1982, M=4.8 earthquake
Trench location
Unconsolidated eolian and lacustrine sediments.
To 0.4m depth, the sediments are warped.
Below 4m sediments are offset by fault.
fault dip ~ 60° E
42' 30"
NWC ACTIVE

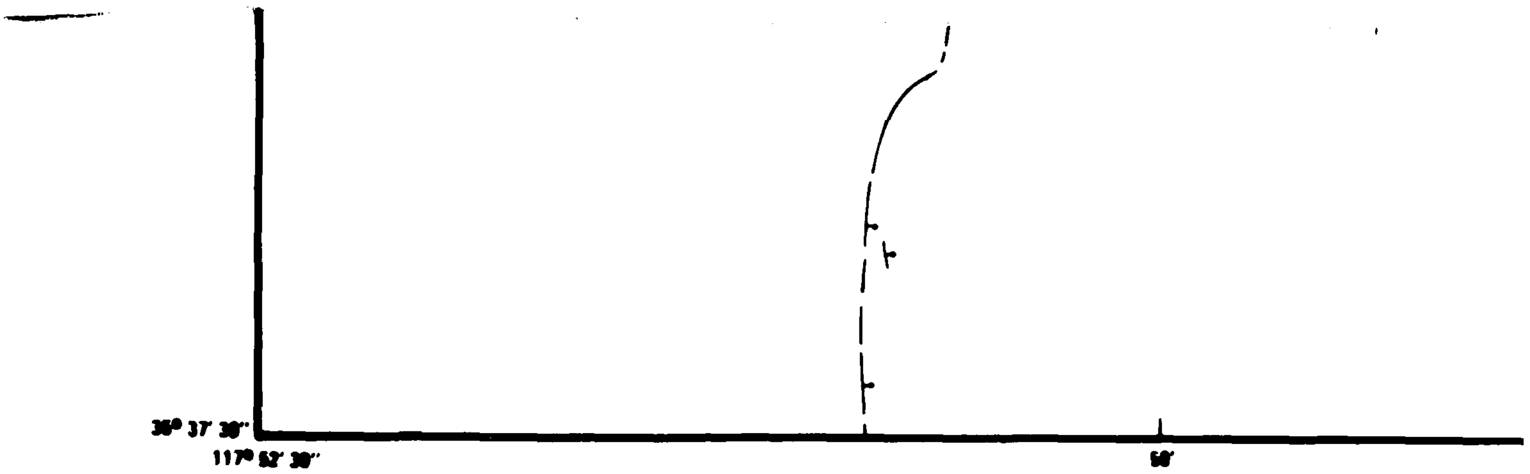


Fault Scarp Profile Data
12.0m / 15° = Scarp height / max scarp angle
No offset in young fan
26.5m / 19.3°
Erosion modified
Rejuvenated stream channel
26.2m / 22.2°
Erosion modified



FAULT MAP SERIES

Depression



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CONTOUR INTERV

DATUM IS MEAN

TOPOGRAPHIC BASE FROM
SURVEY INYOKERN, CALI
7.5' QUADRANGLE 1972

CARTOGRAPHY BY

GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

EXPLANAT

?

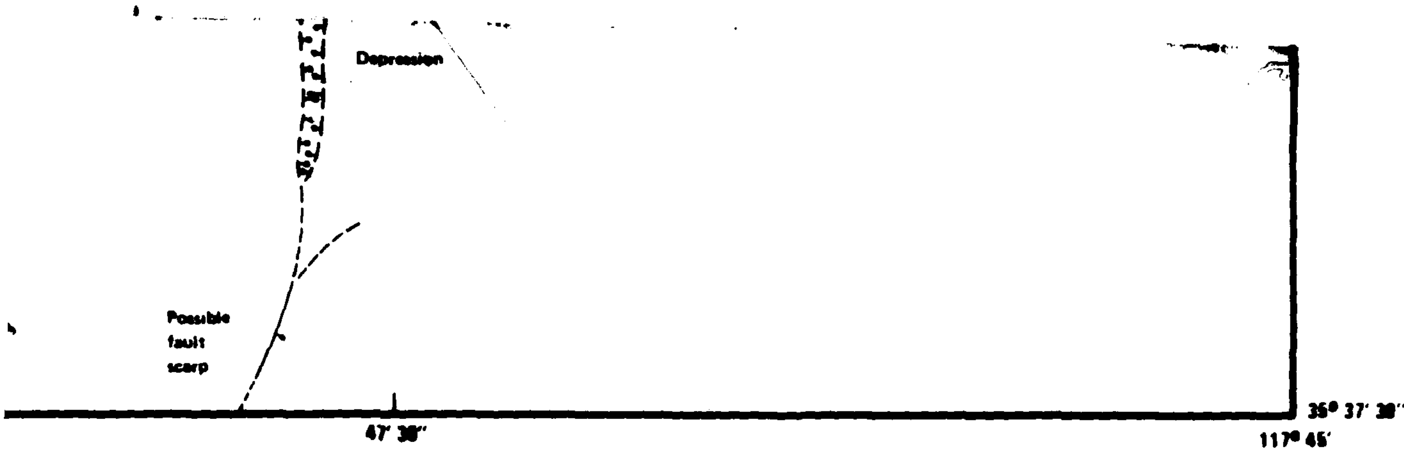
Fault trac

Solid line, field or photogeologic evidence
scarps, trenches, sag ponds, or other surf
scars where noted; queried line, possib
interpretations not excluded; dashed line
distinctive surficial features of faulting no
active fault trace concealed by very rec
regarded as approximate); ball on down th
of relative motion

Other recently active breaks that have
features may be present

[1] The brief notes along the fault traces indicate locations
clear. Fault trace features are not limited to these locati
the mapped fault lines

Pleistocene Lake



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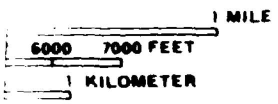
J. T. ZELLMER 1986



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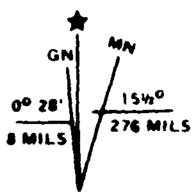

UTM GRID & 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

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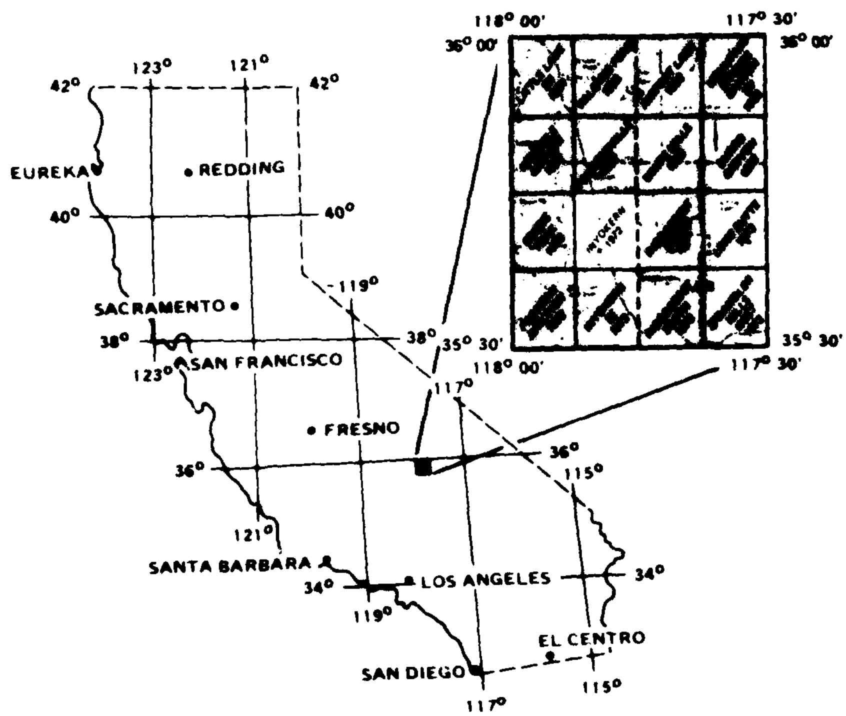
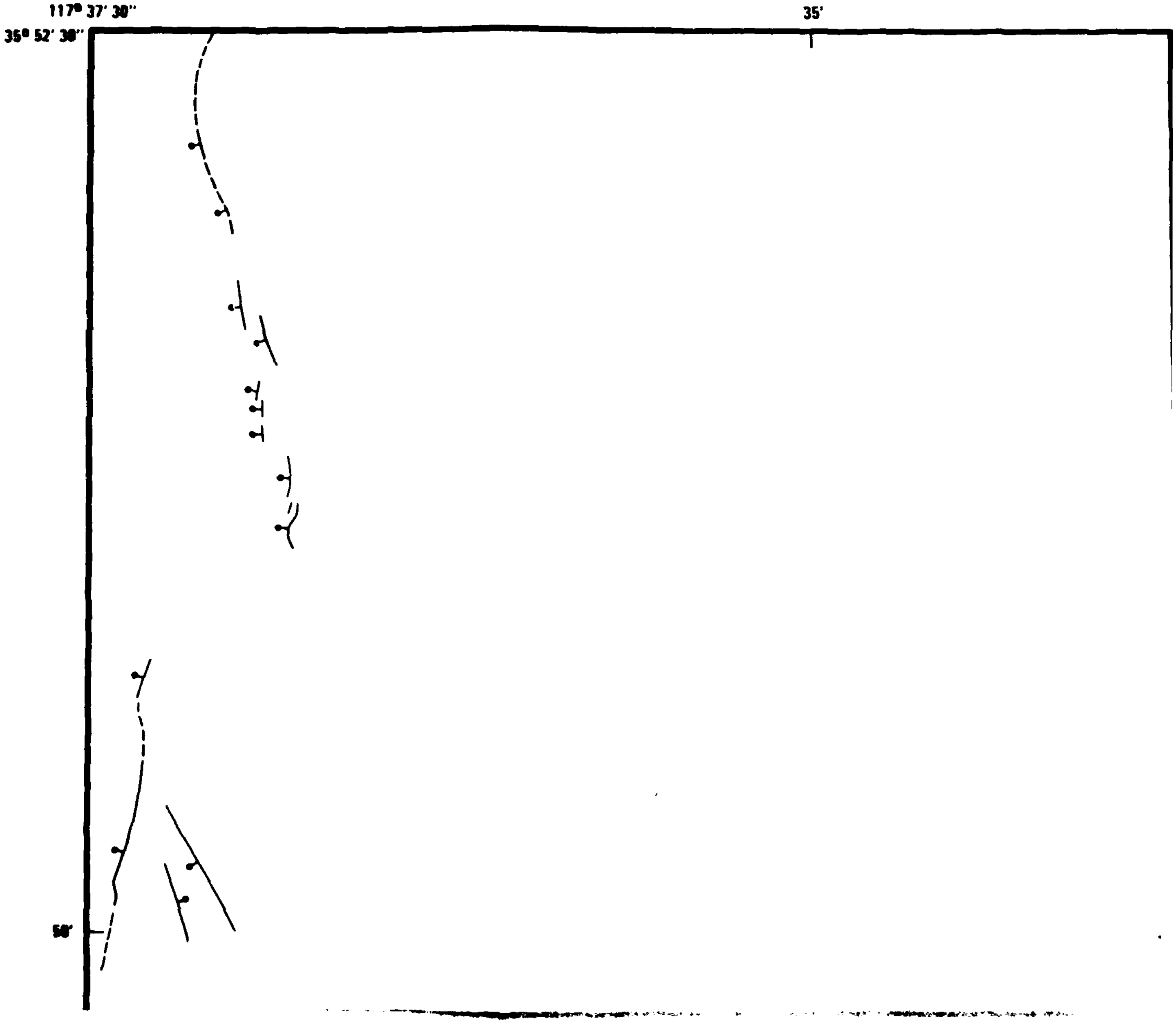


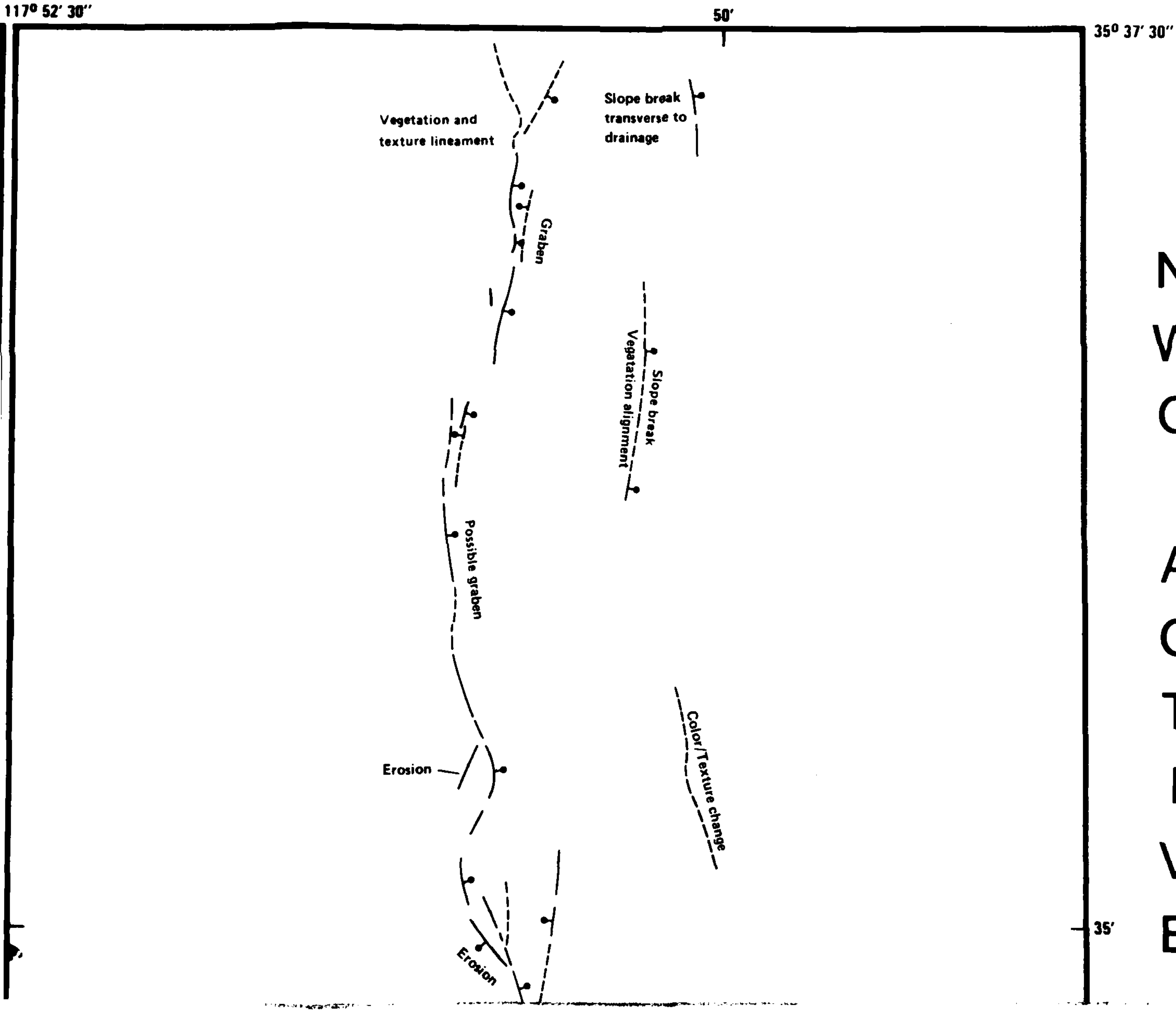
P.

BURRO CANYON QUADRANGLE

CALIFORNIA – INYO CO., SAN BERNARDINO CO



INYOKERN SOUTHEAST QUADRANGLE
CALIFORNIA – KERN CO.



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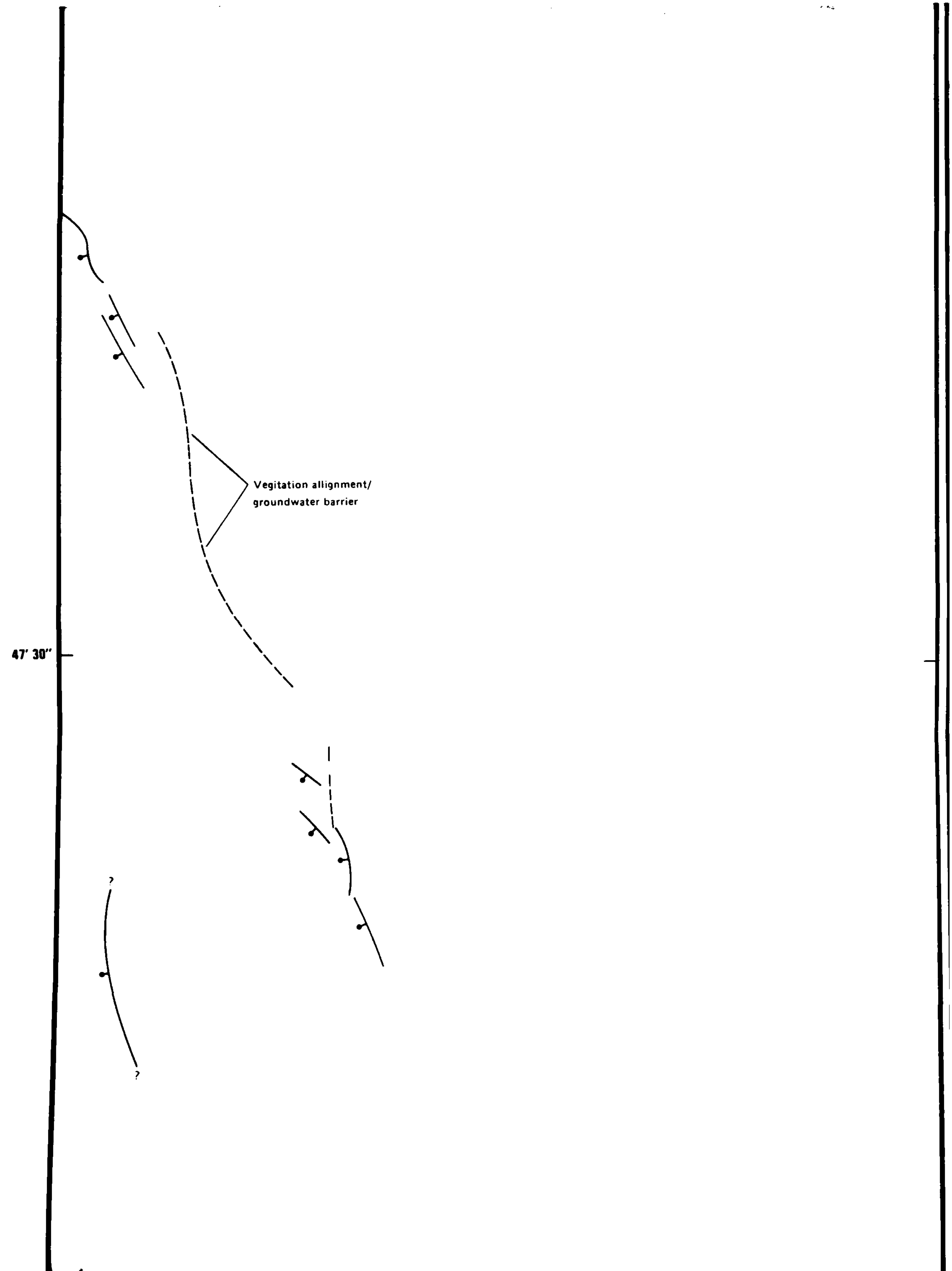
Vegitation allignment/
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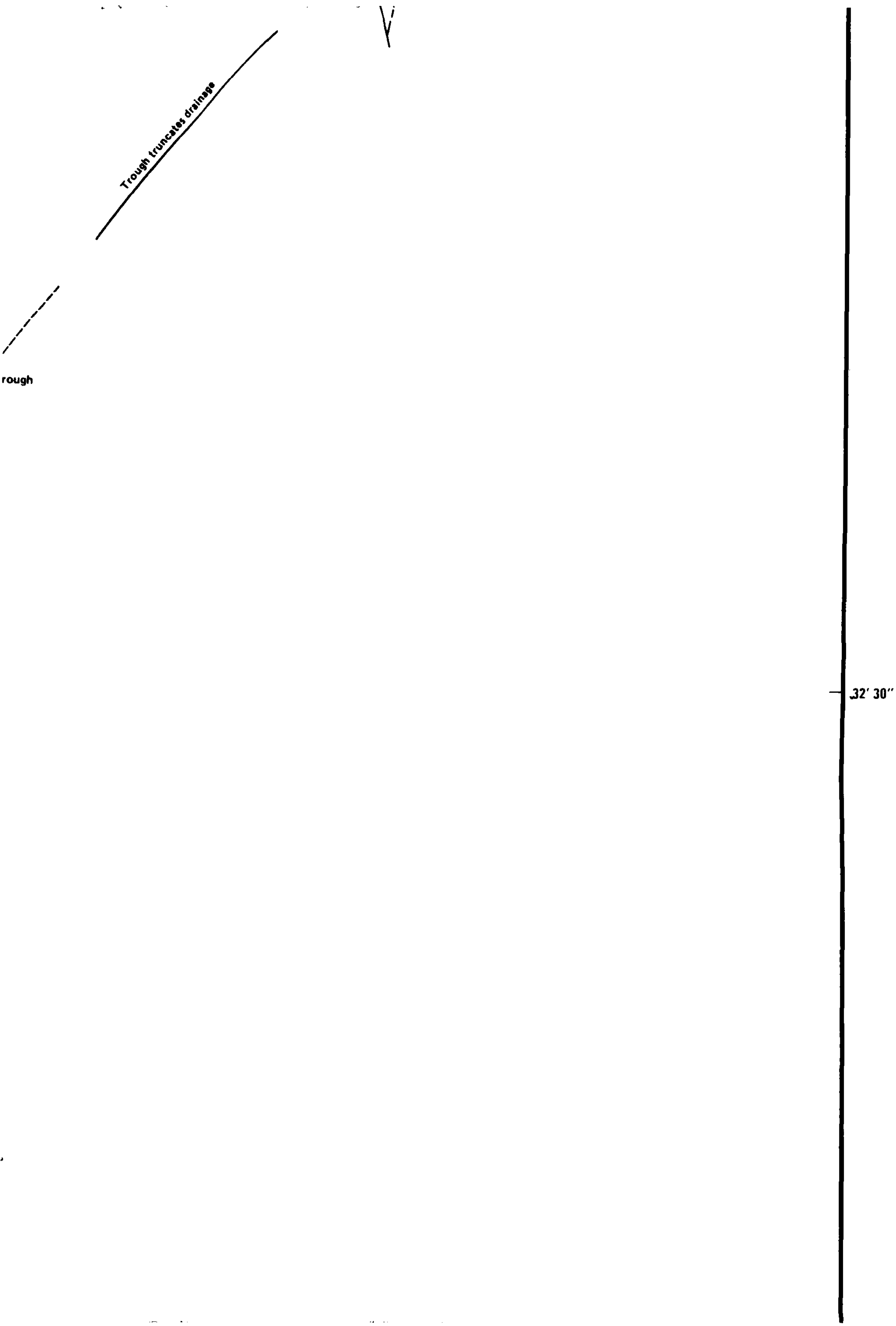

FAULT MAP SERIES

35° 45
117° 37′ 30″
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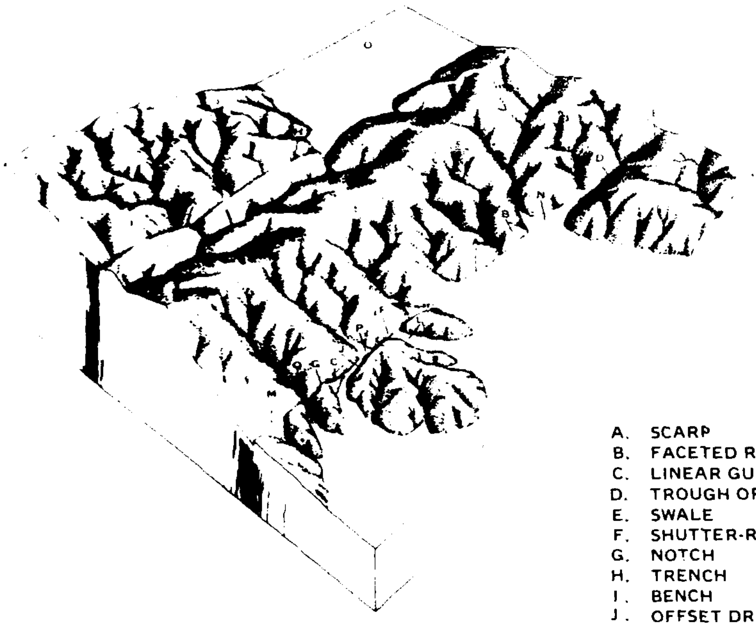

GENERALIZED DIAGRAM OF FAULT FEATURES

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E. SWALE
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I. BENCH
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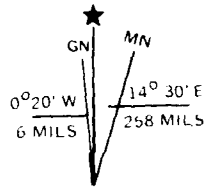
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL
WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING



UTM GRID & 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

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CONTOUR INTERVALS, 2
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TOPOGRAPHIC BASE FROM U.S. GEOLC
SURVEY BURRO CANYON, CALIFORNI
AND INYOKERN SOUTHEAST, CALIFOF

CARTOGRAPHY BY P. O'D

EXPLANATION

?

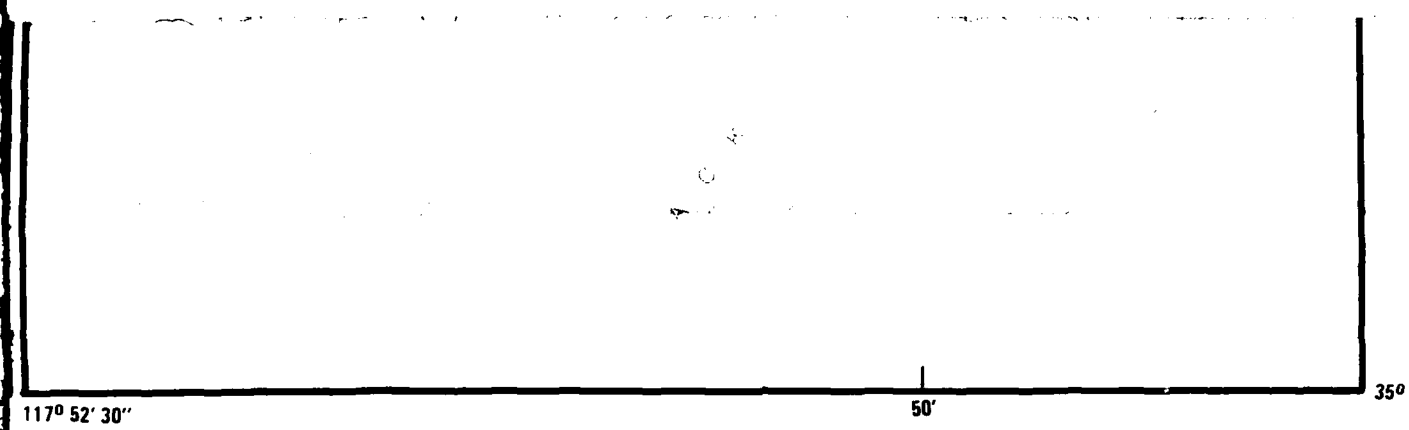
Fault trace

Solid line, field or photogeologic evidence of rec scarps, trenches, sag ponds, or other surface feat scars where noted; queried line, possible recer interpretations not excluded; dashed line, probab distinctive surficial features of faulting not preser active fault trace concealed by very recent allu regarded as approximatel, ball on down thrown si of relative motion

Other recently active breaks that have not pro features may be present

[1] The brief notes along the fault traces indicate locations where th clear. Fault trace features are not limited to these localities but ar the mapped fault lines

Pleistocene Lake Shor



BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

1 MILE
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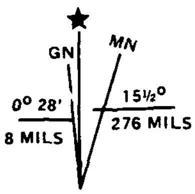
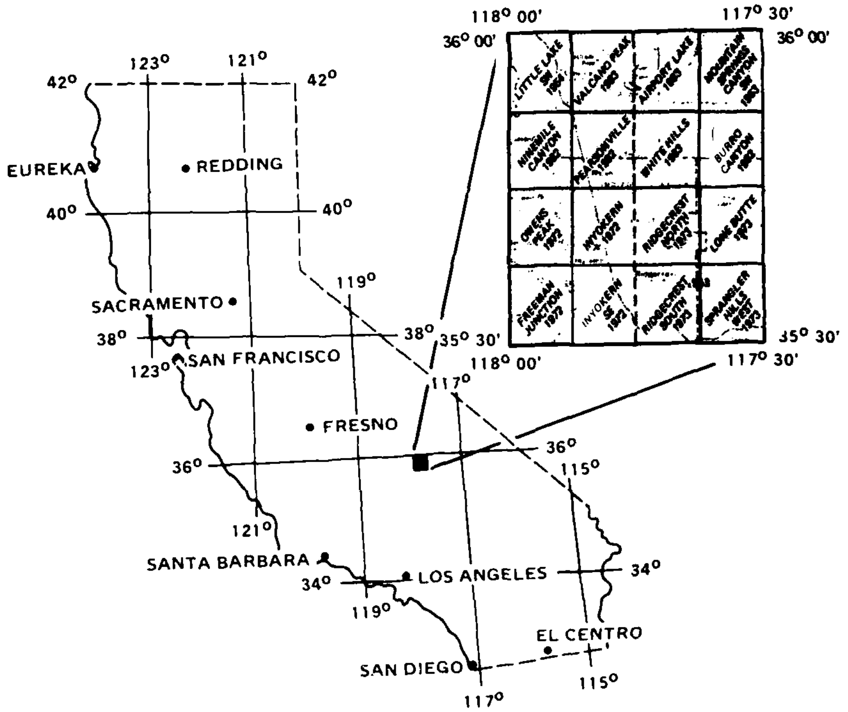


UTM GRID & 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



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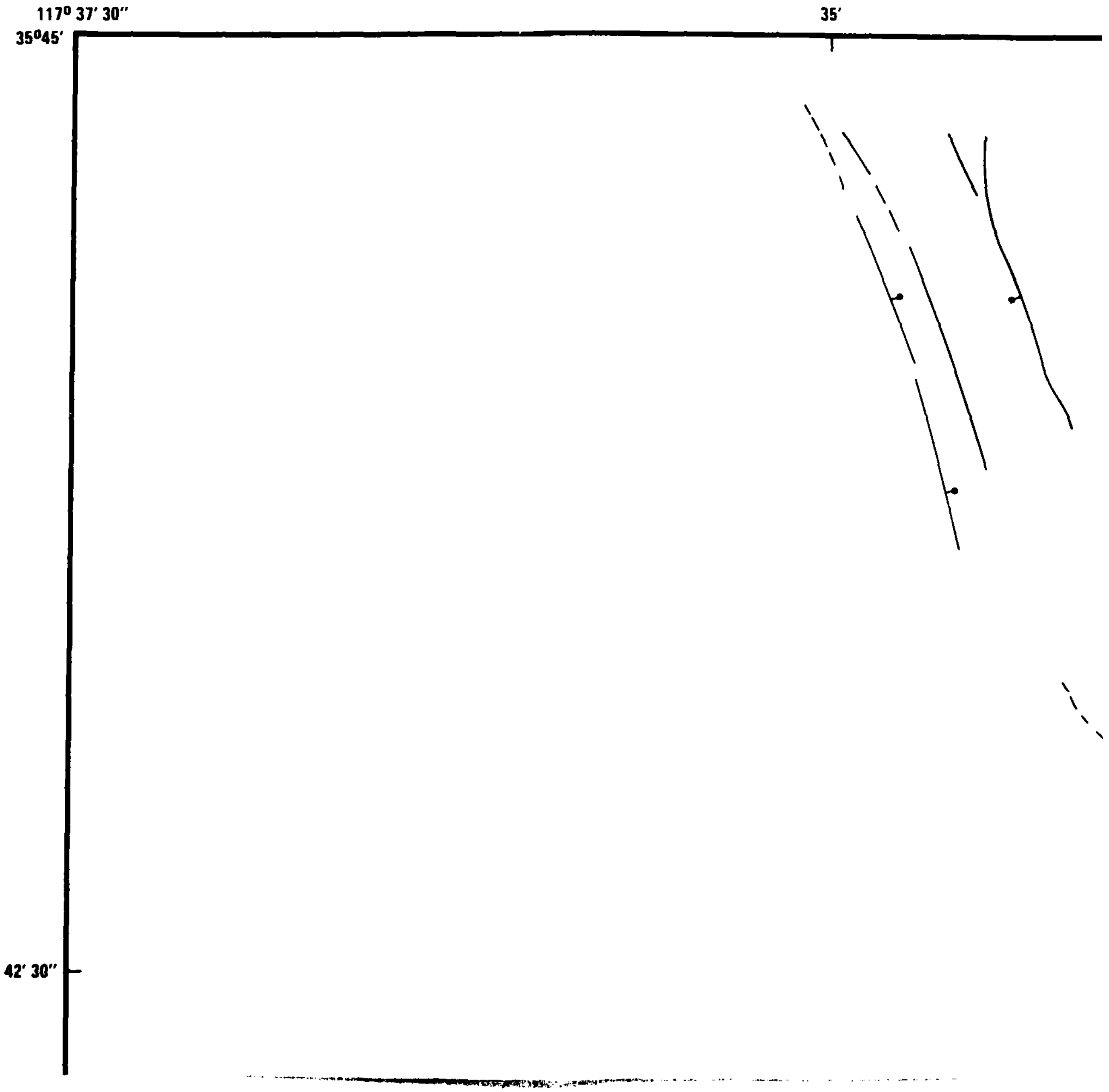
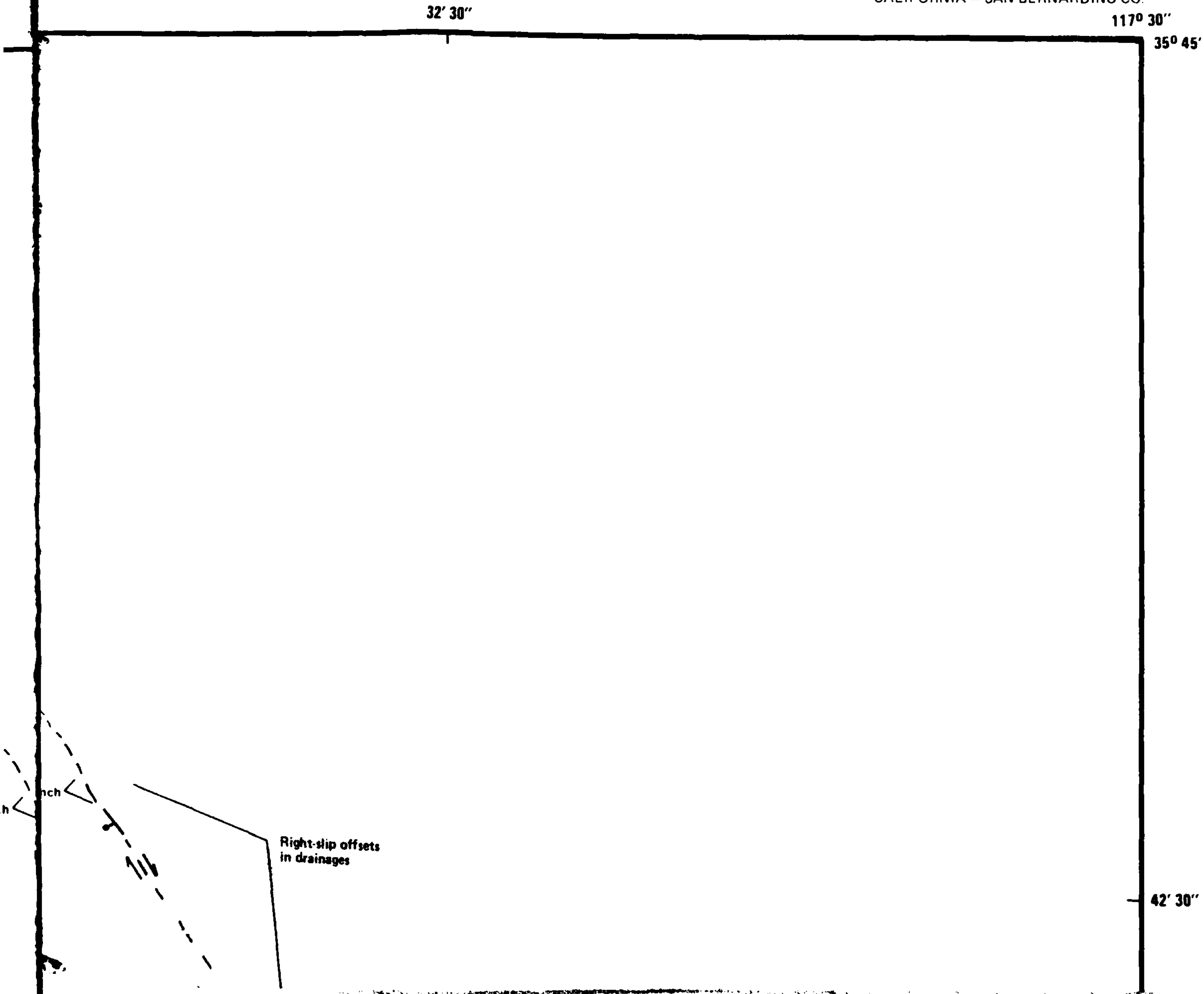
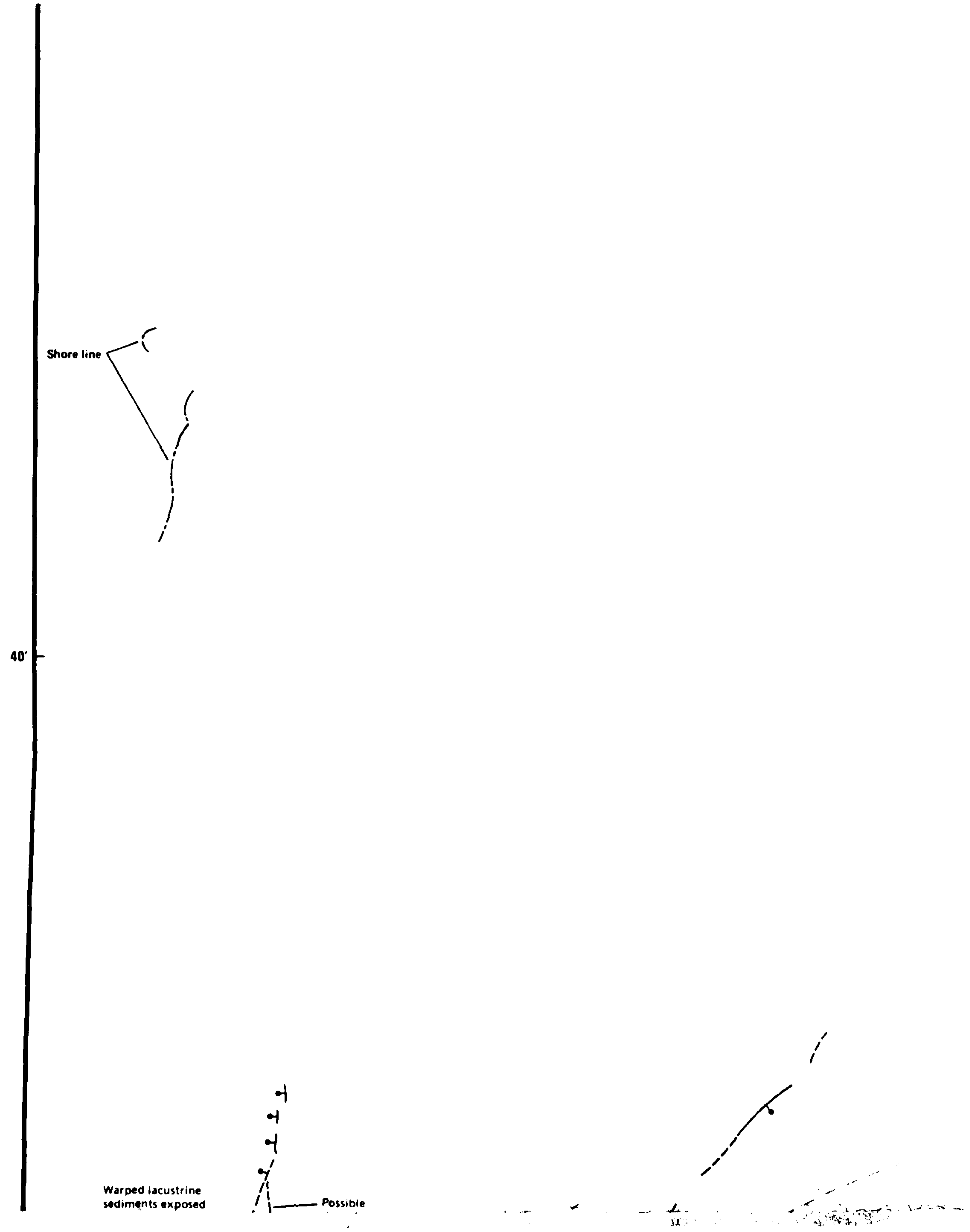
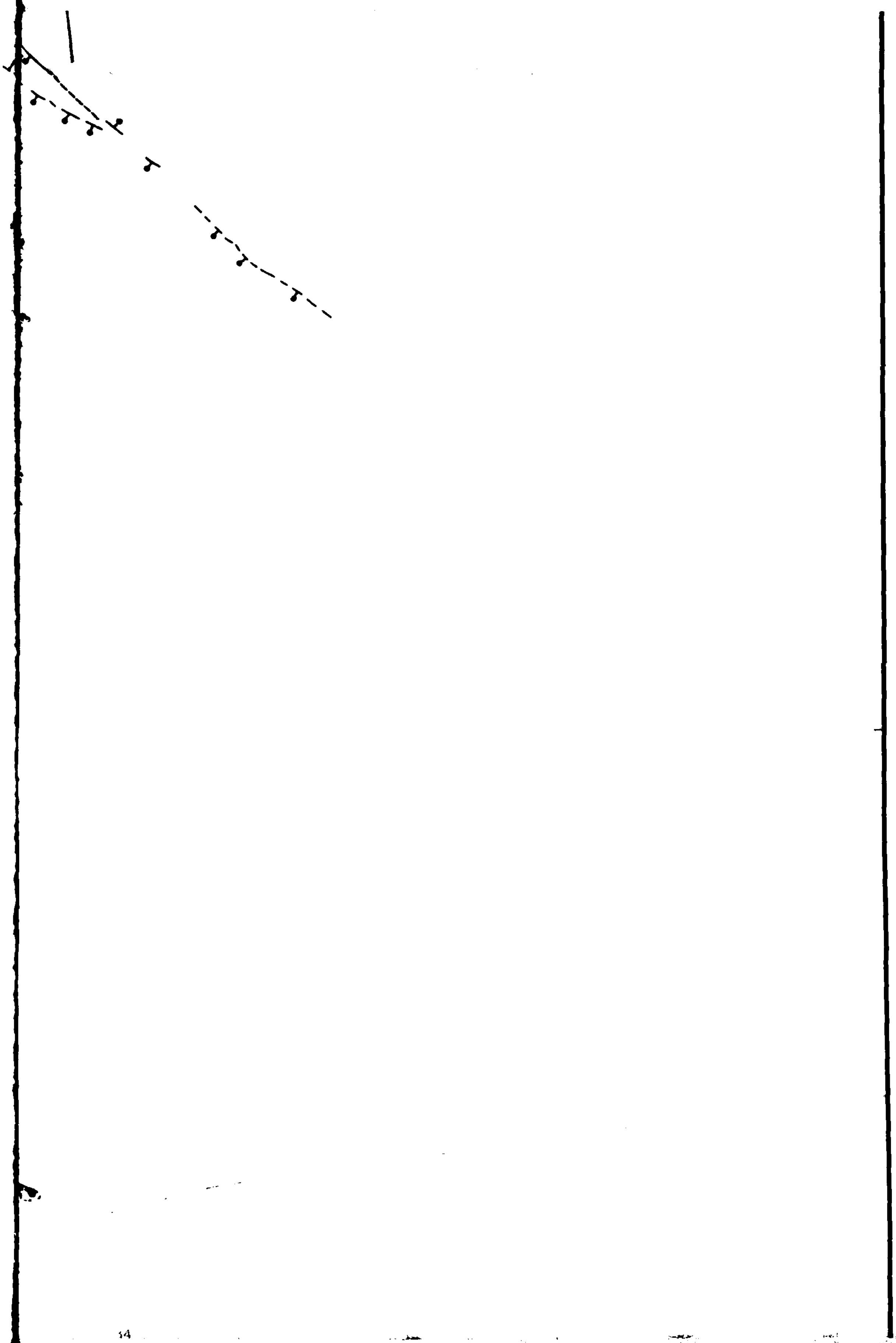

117° 37′ 30″
35°45′
35′
42′ 30″

LONE BUTTE QUADRANGLE
CALIFORNIA – SAN BERNARDINO CO.

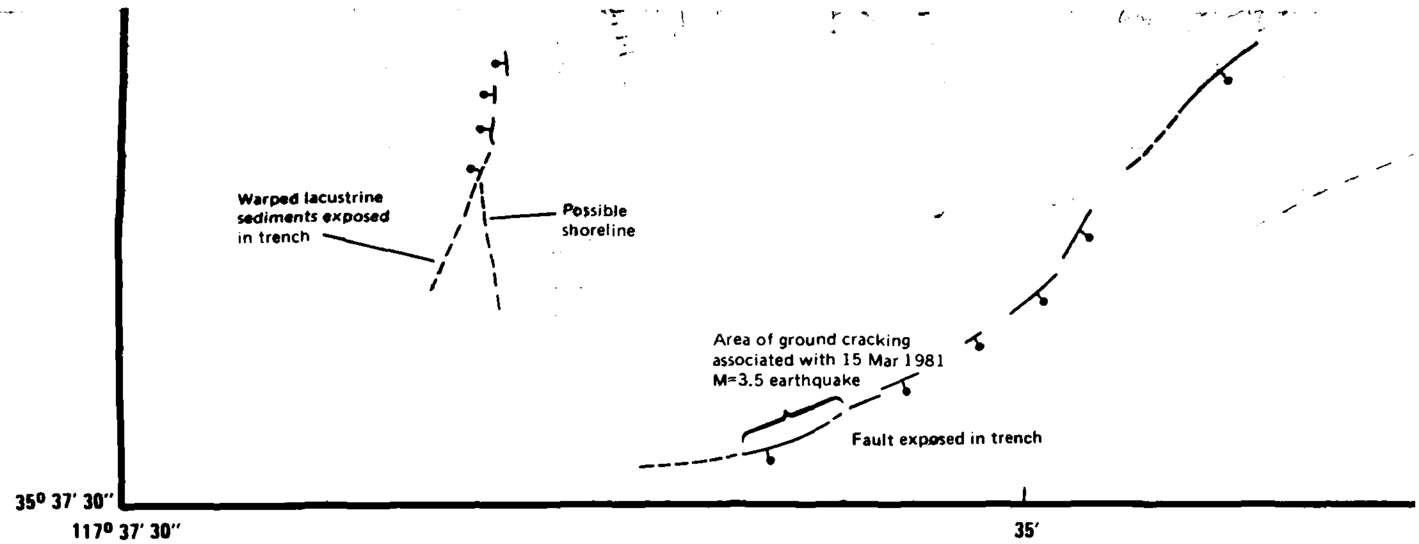


NWC ACTIVE


Shore line
40′
Warped lacustrine
sediments exposed
Possible



FAULT MAP SERIES



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CONTOUR INTERVAL

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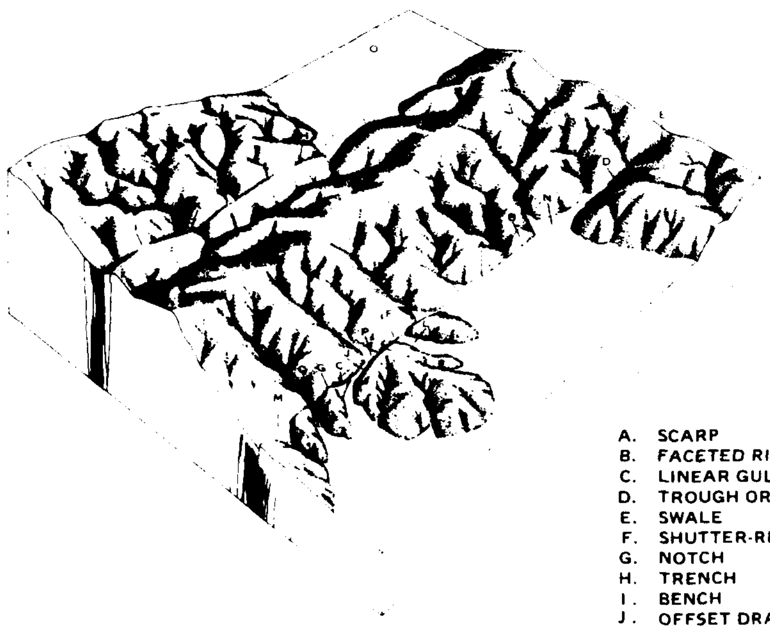
TOPOGRAPHIC BASE FROM U
SURVEY LONE BUTTE, CALI
7.5' QUADRANGLE 1973

CARTOGRAPHY BY P.



GENERALIZED DIAGRAM OF FAULT FEATURES

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B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
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M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

EXPLANATIC

?

Fault trace

Solid line, field or photogeologic evidence of scarps, trenches, sag ponds, or other surface scars where noted; queried line, possible re interpretations not excluded, dashed line, pro distinctive surficial features of faulting not pr active fault trace concealed by very recent regarded as approximatel; ball on down thrown of relative motion

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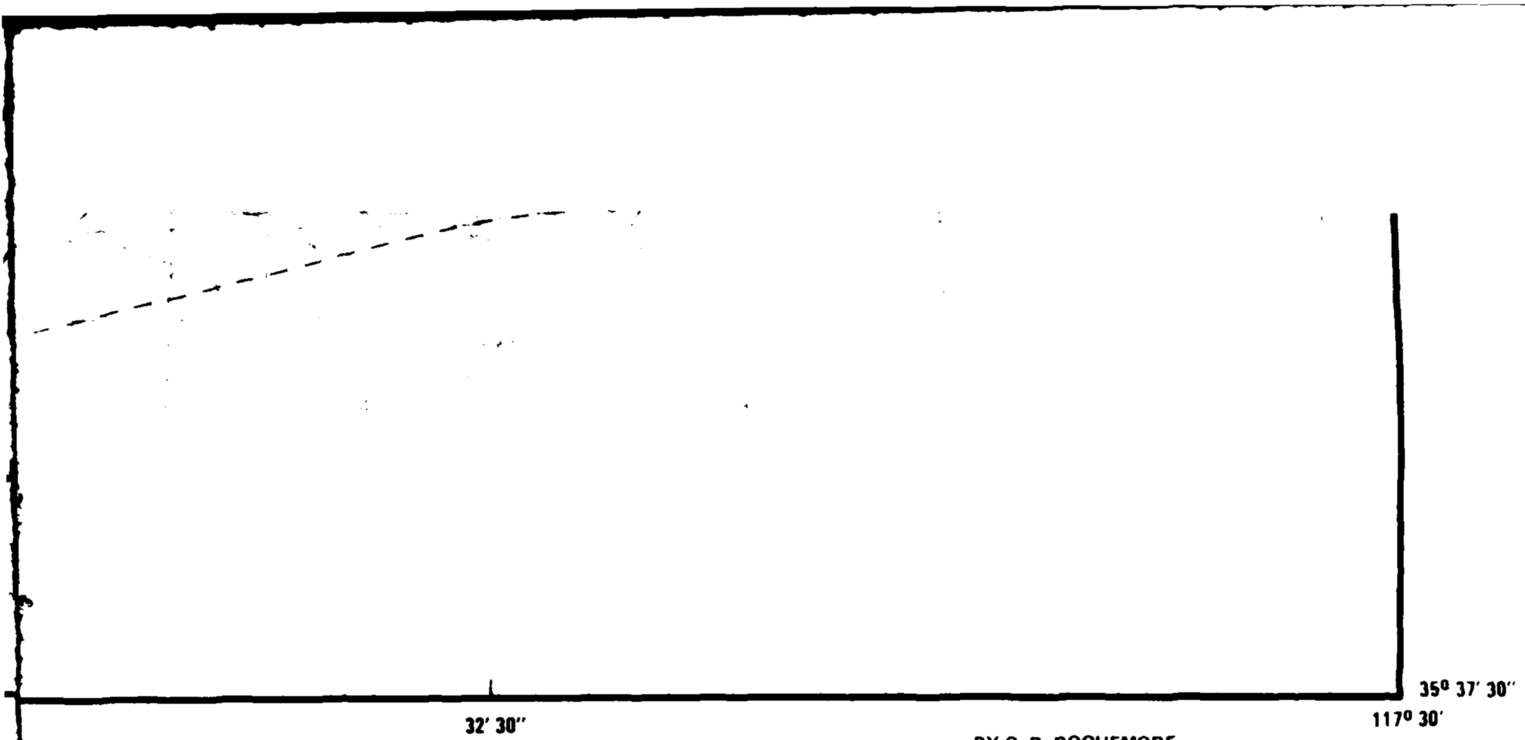
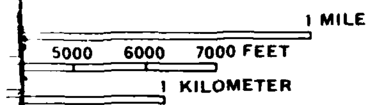
Pleistocene Lake Sh



BY G. R. ROQUEMORE,
J. T. ZELLMER 1986



D FEET
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resent to some degree all along

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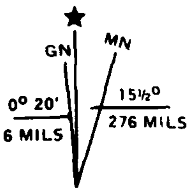
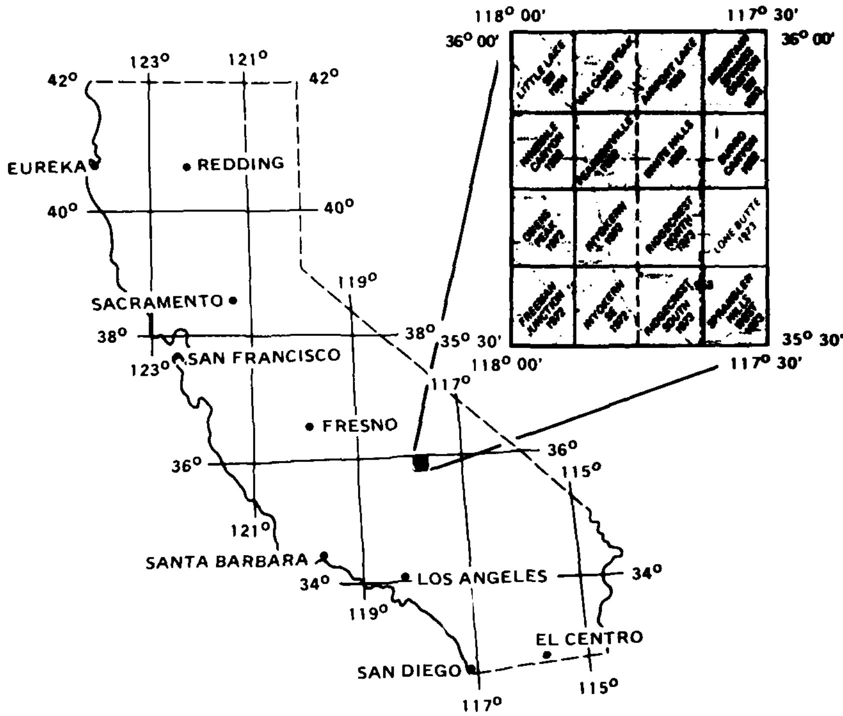
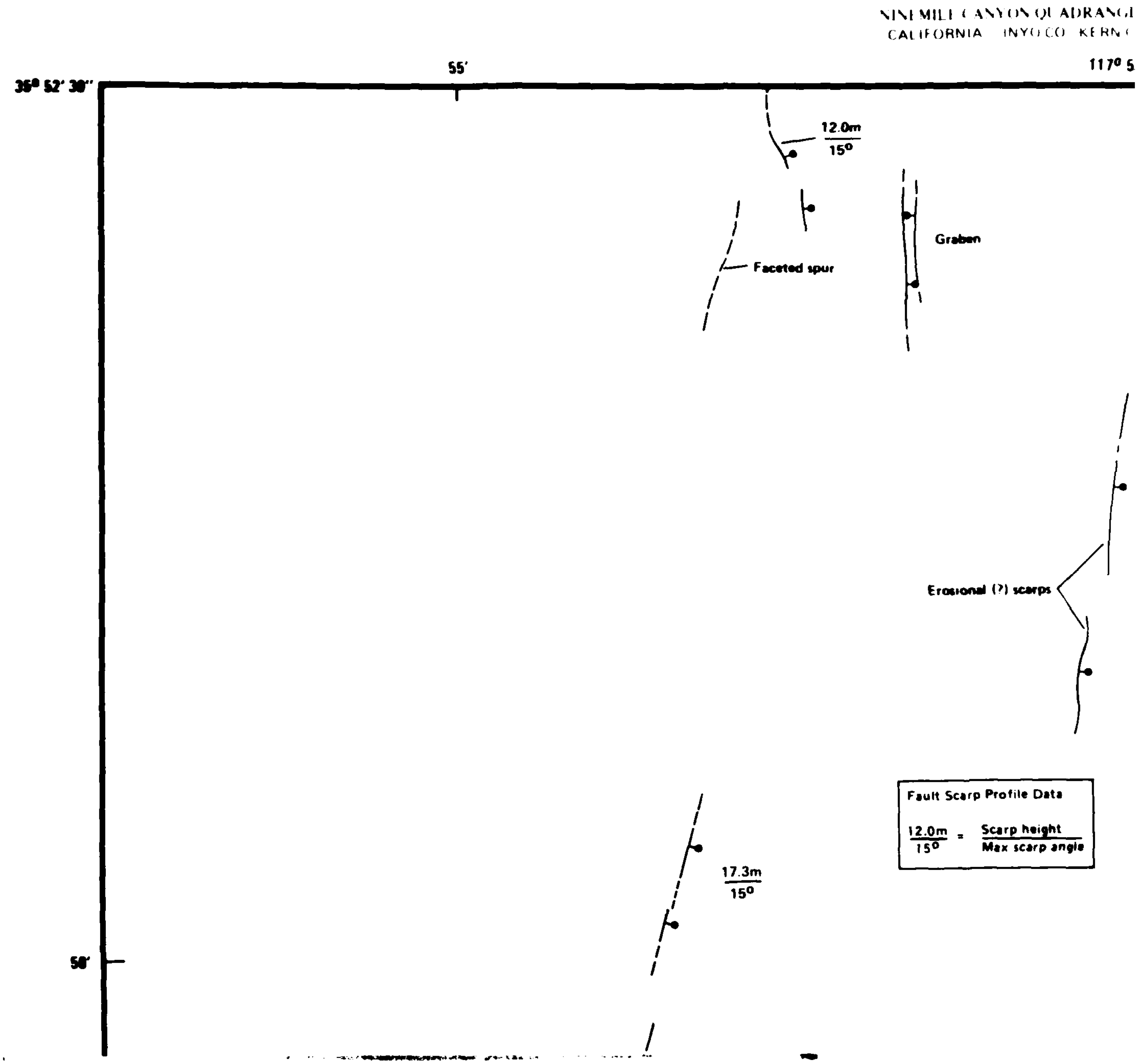
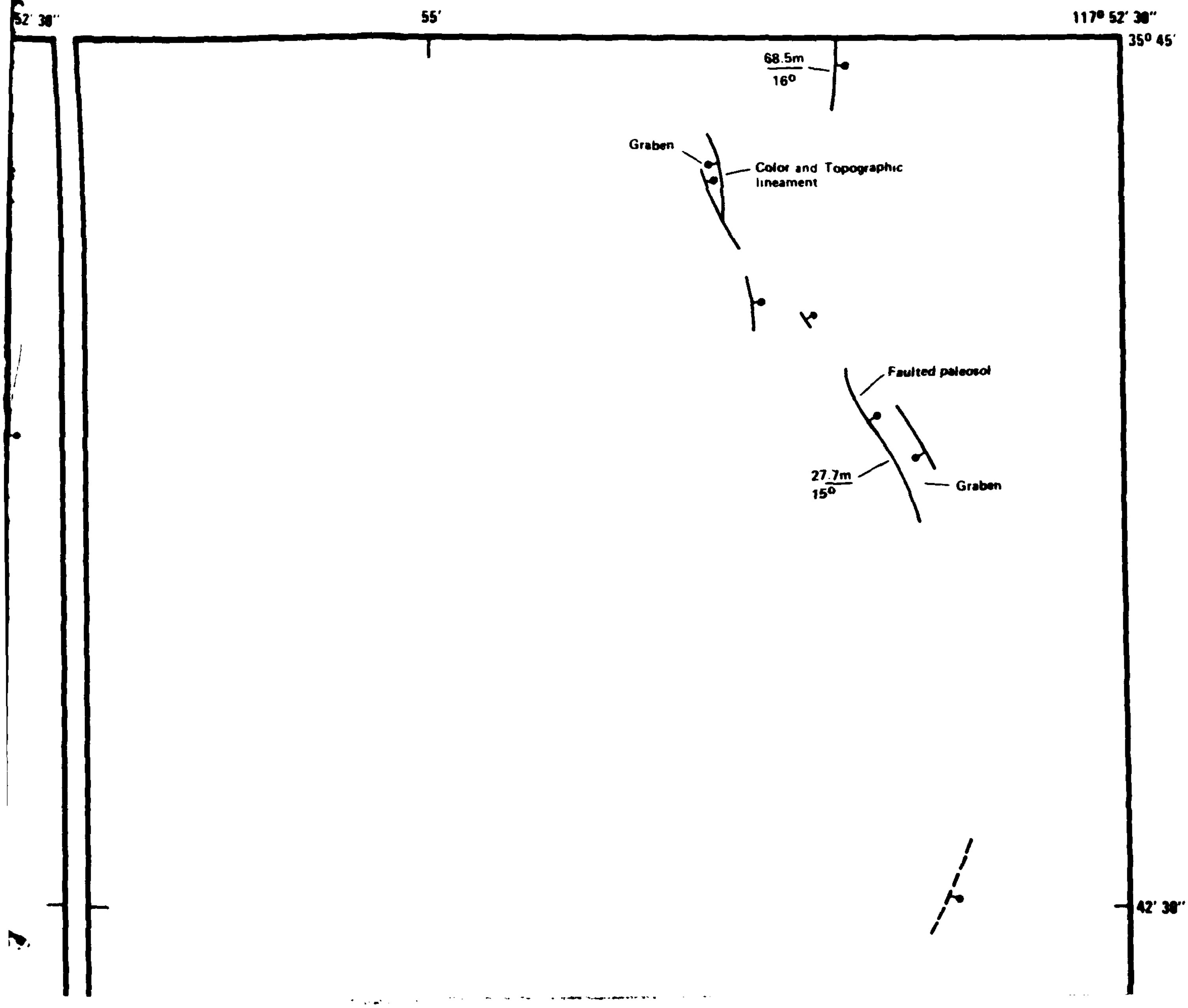


UTM GRID & 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

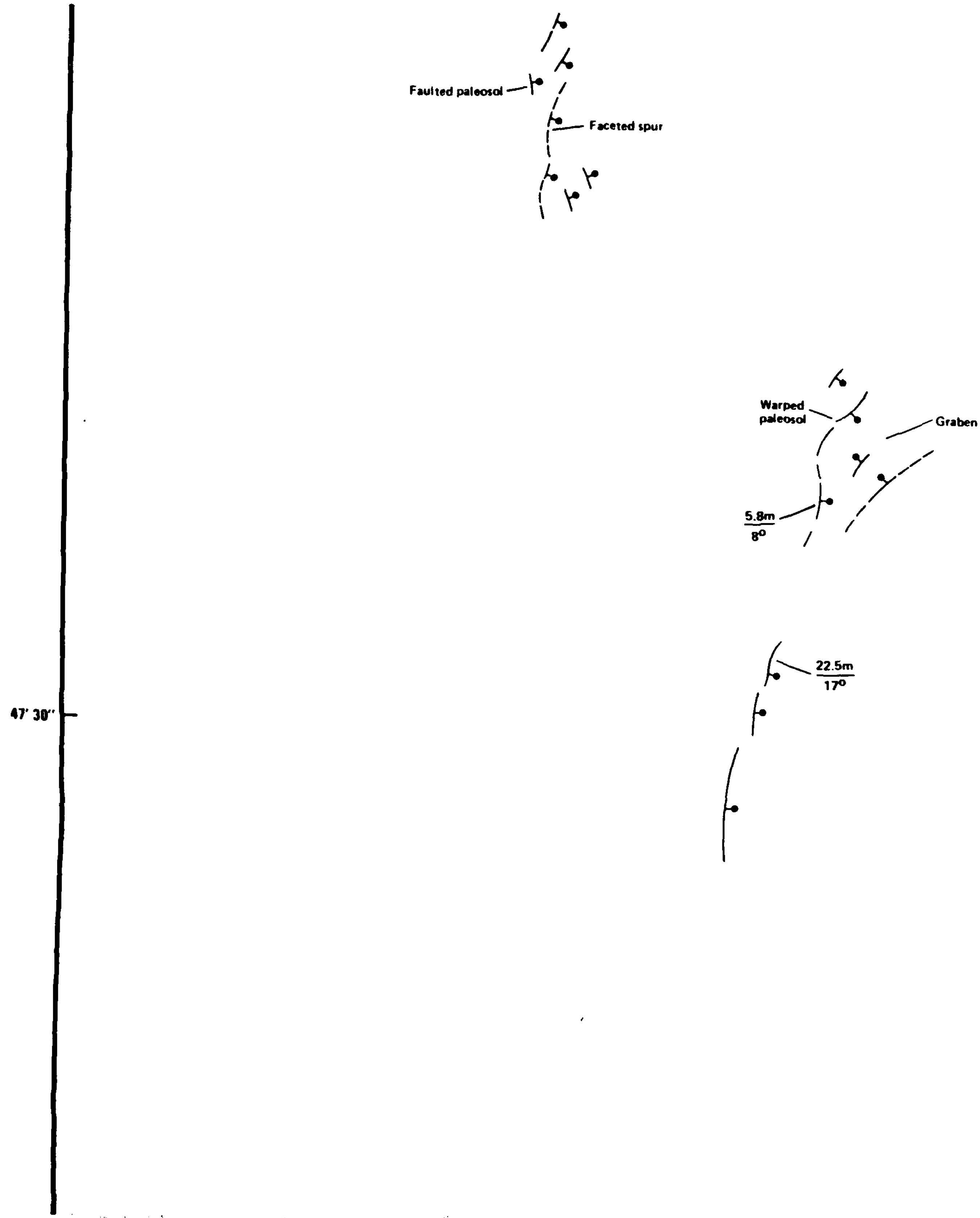



NINEMILE CANYON QUADRANGLE
CALIFORNIA INYO CO. KERN C
55'
117° 5
35° 52' 30"
12.0m
15°
Graben
Faceted spur
Erosional (?) scarps
Fault Scarp Profile Data
12.0m / 15° = Scarp height / Max scarp angle
17.3m
15°
50'

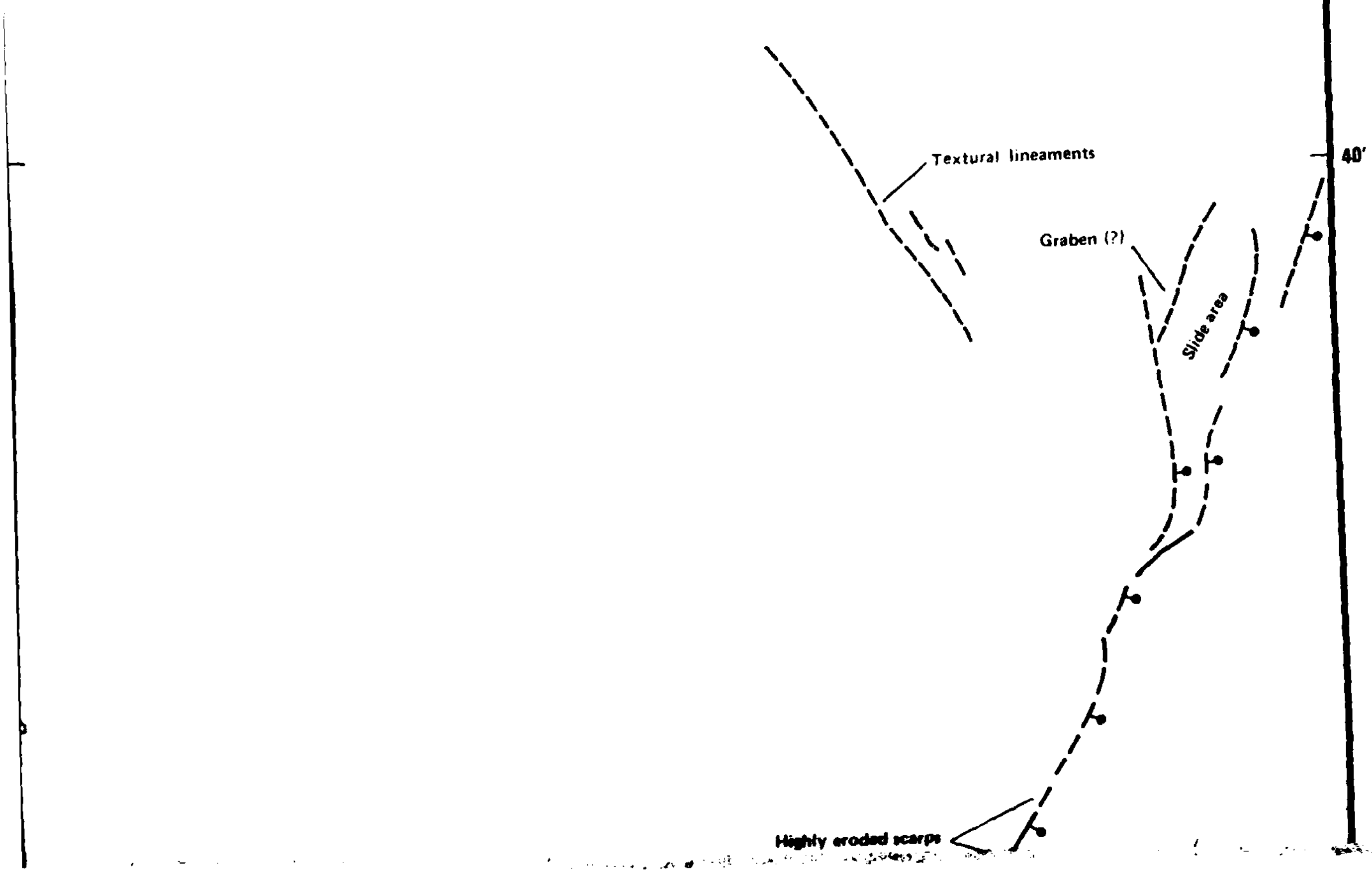
OWENS PEAK QUADRANGLE
CALIFORNIA KERN CO



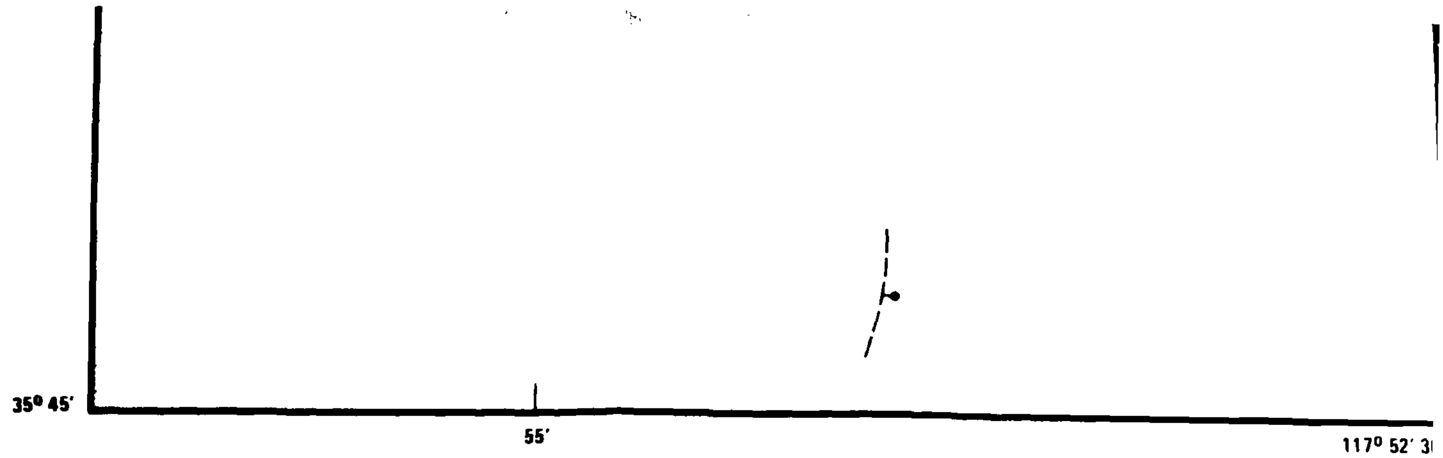
NWC ACTIVE



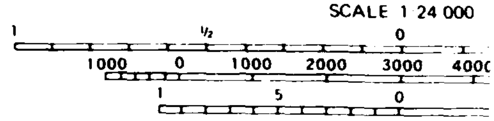
Faulted paleosol
Faceted spur
Warped paleosol
Graben
5.8m
8°
22.5m
17°
47' 30"



FAULT MAP SERIES



SCALE 1:24 000



CONTOUR INTERVALS, 4

DATUM IS MEAN SEA LE

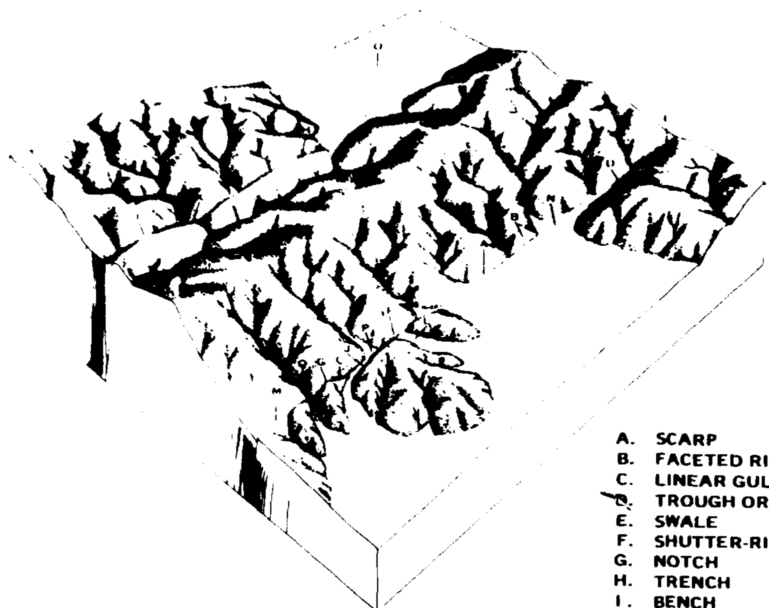
TOPOGRAPHIC BASE F···OM U.S

SURVEY NINEMILE CANYON, C

QUADRANGLE 7.5' 1982 AND O

CALIFORNIA 7.5' QUADRANGL

CARTOGRAPHY BY P. O'D



GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

EXPLANATION

?

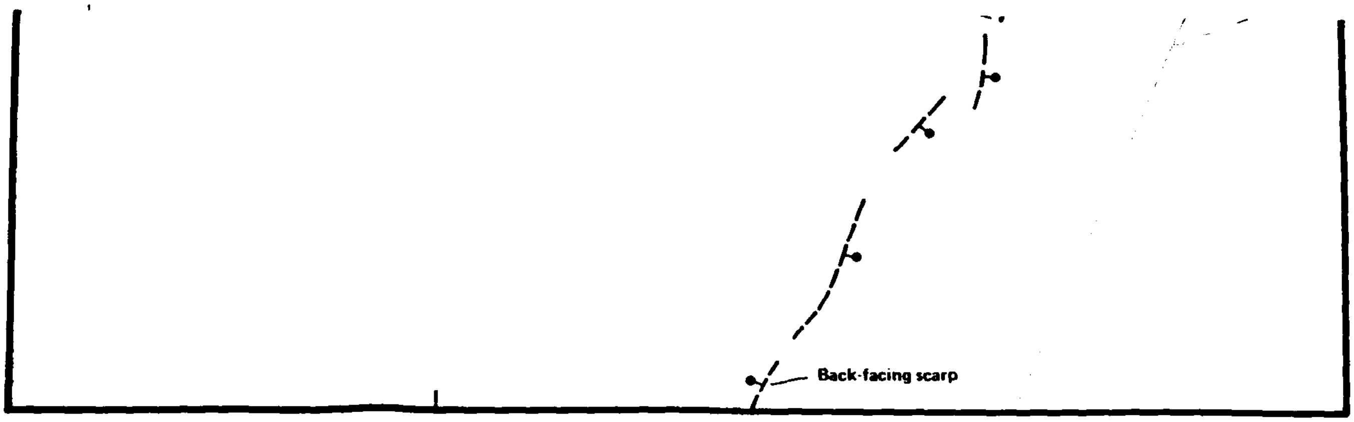
Fault trace

Solid line, field or photogeologic evidence of rec scarps, trenches, sag ponds, or other surface feat scars where noted, queried line, possible recen interpretations not excluded, dashed line, probab distinctive surficial features of faulting not prese active fault trace concealed by very recent a regarded as approximate), ball on down thrown si of relative motion

Other recently active breaks that have not proc features may be present

[1] The brief notes along the fault traces indicate locations where the clear. Fault trace features are not limited to these localities but are the mapped fault lines

Pleistocene Lake Shore



BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

1 MILE
5000 6000 7000 FEET
1 KILOMETER

FEET
EL

EOLOGICAL
LIFORNIA
ENS PEAK,
1972
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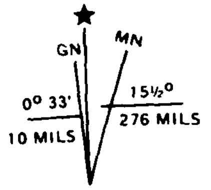

UTM GRID & 1972 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

nt movement shown by res.[1] including landslide fault scarp, but other recent movement, but dotted line, potentially um (position should be arrows show direction

iced distinctive surficial

eatures mentioned are especially esent to some degree, all along

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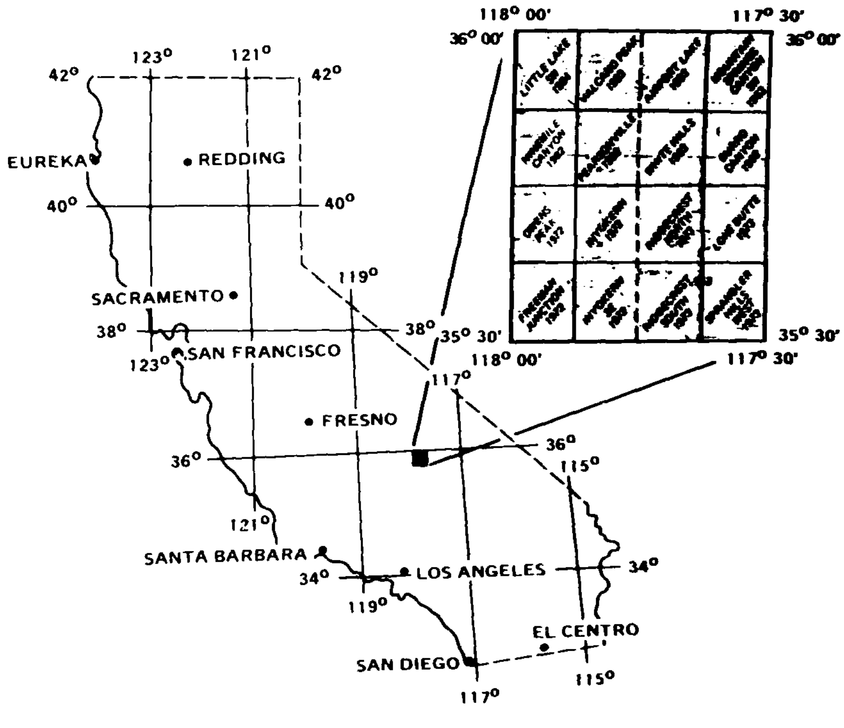
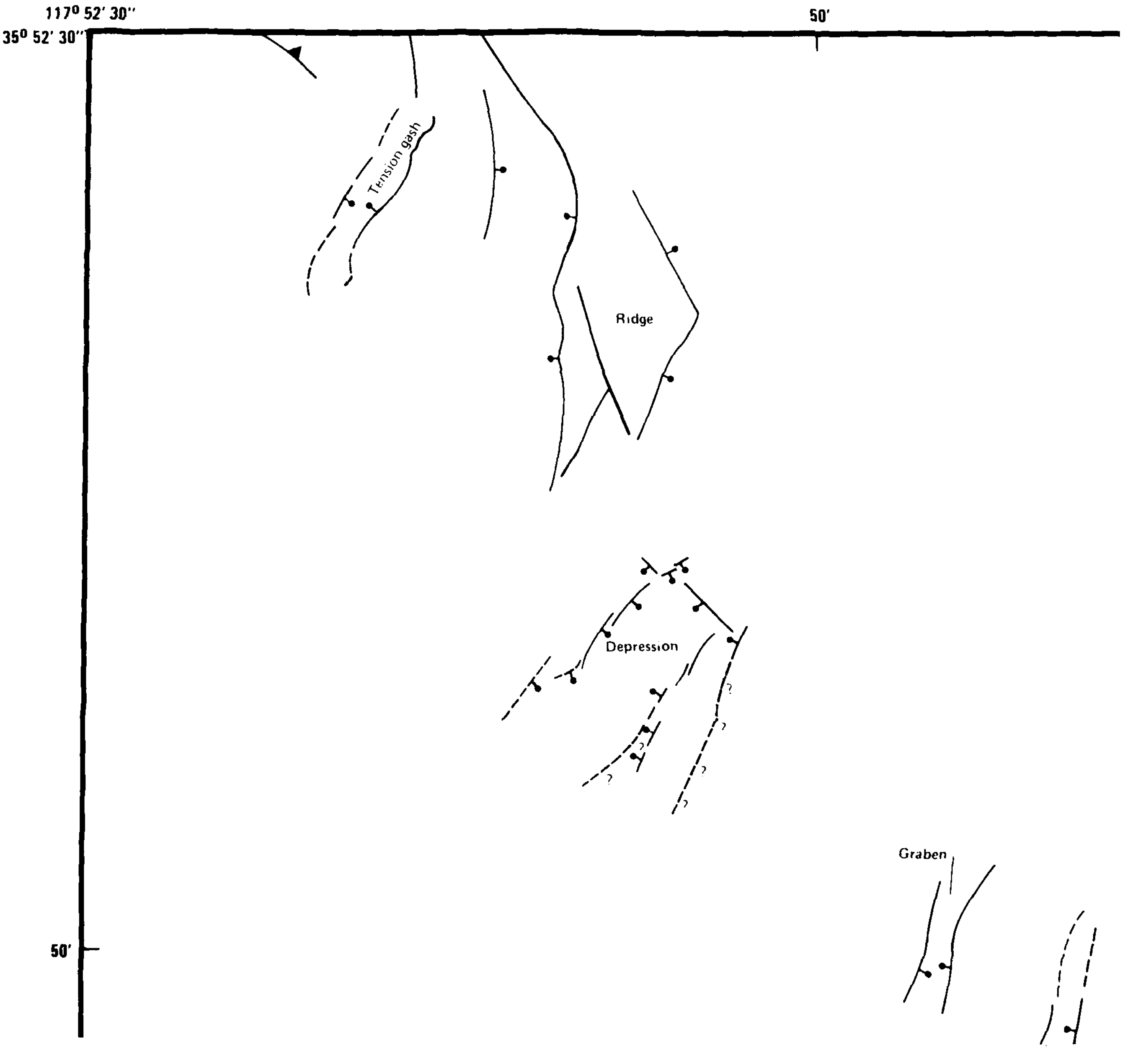
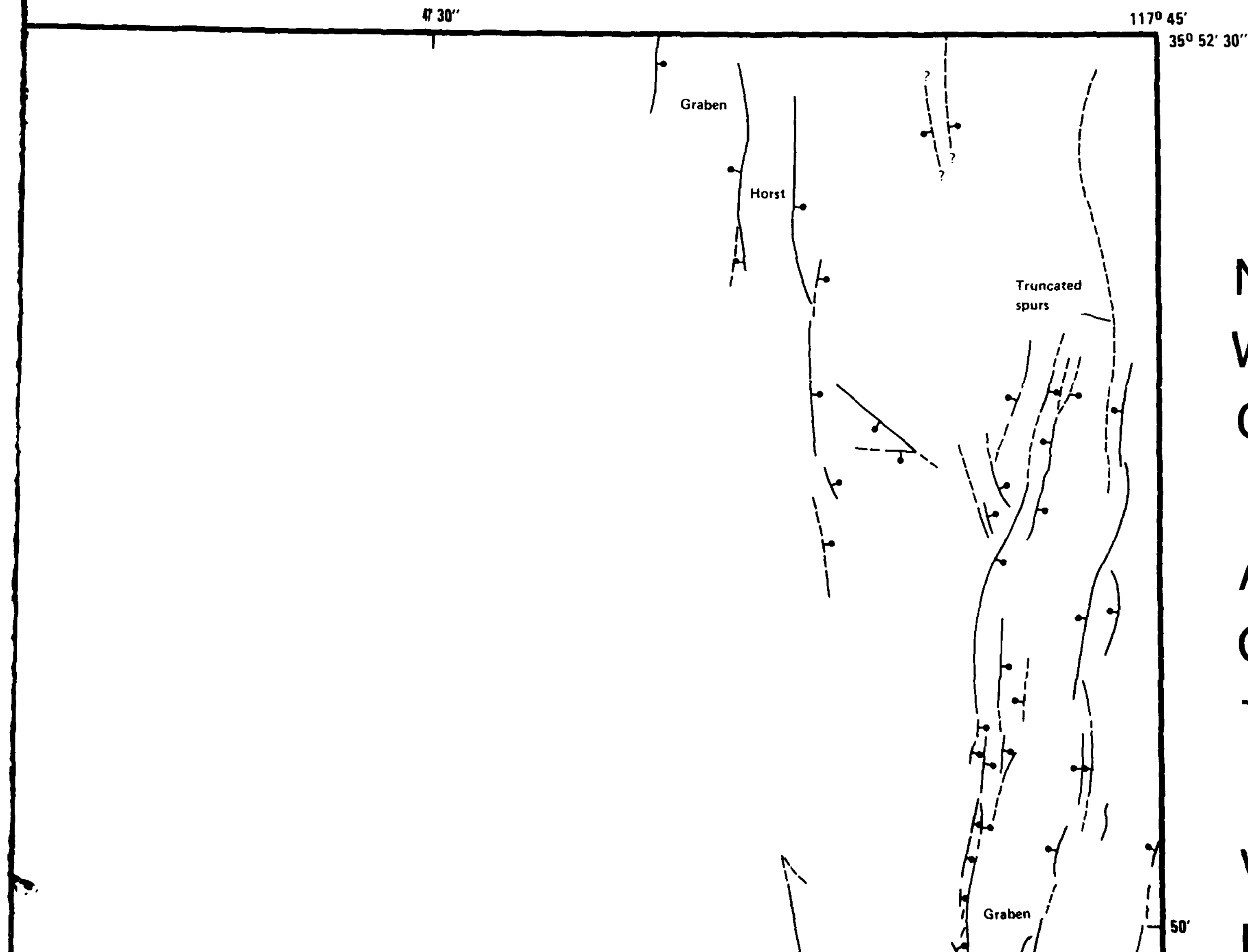
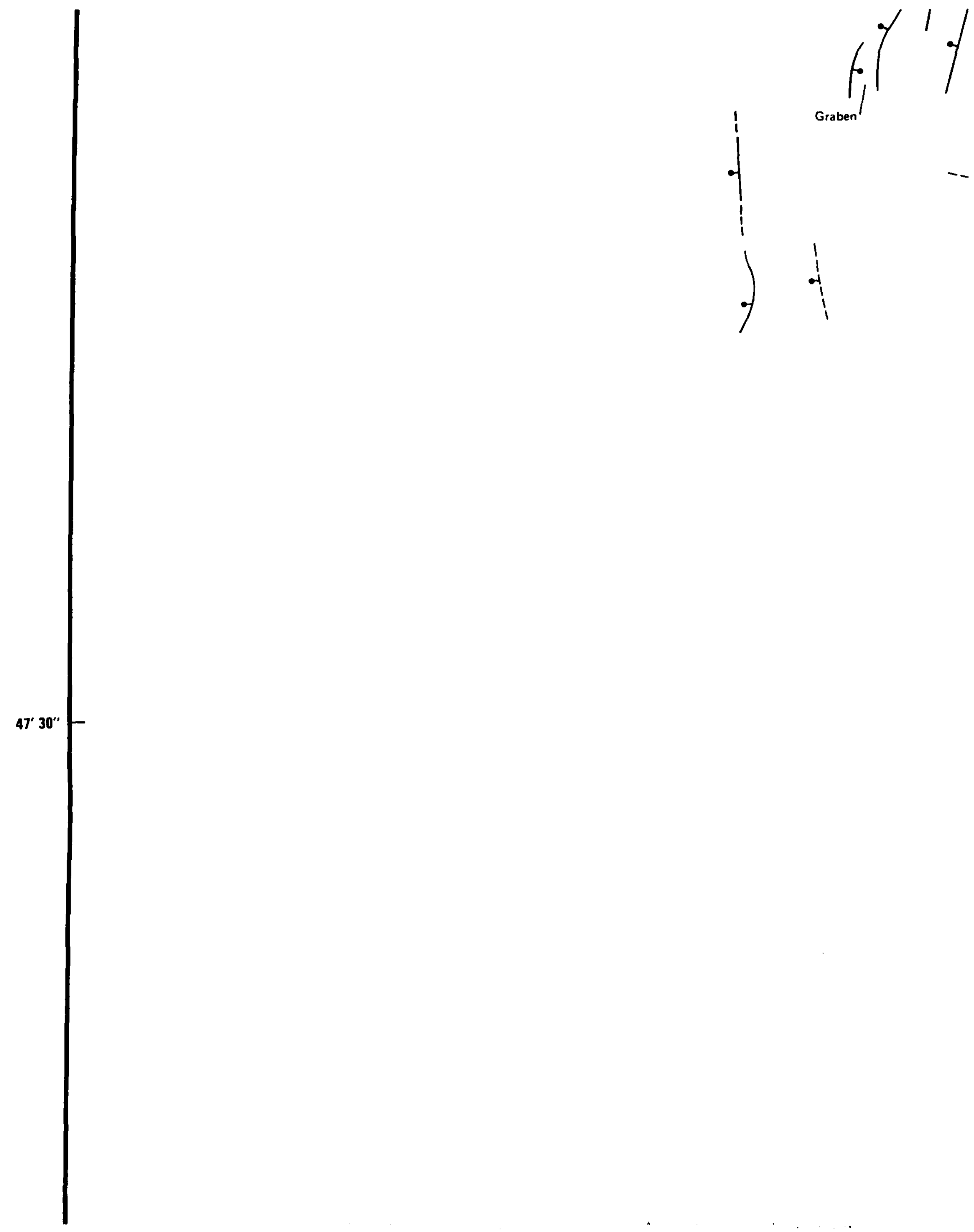


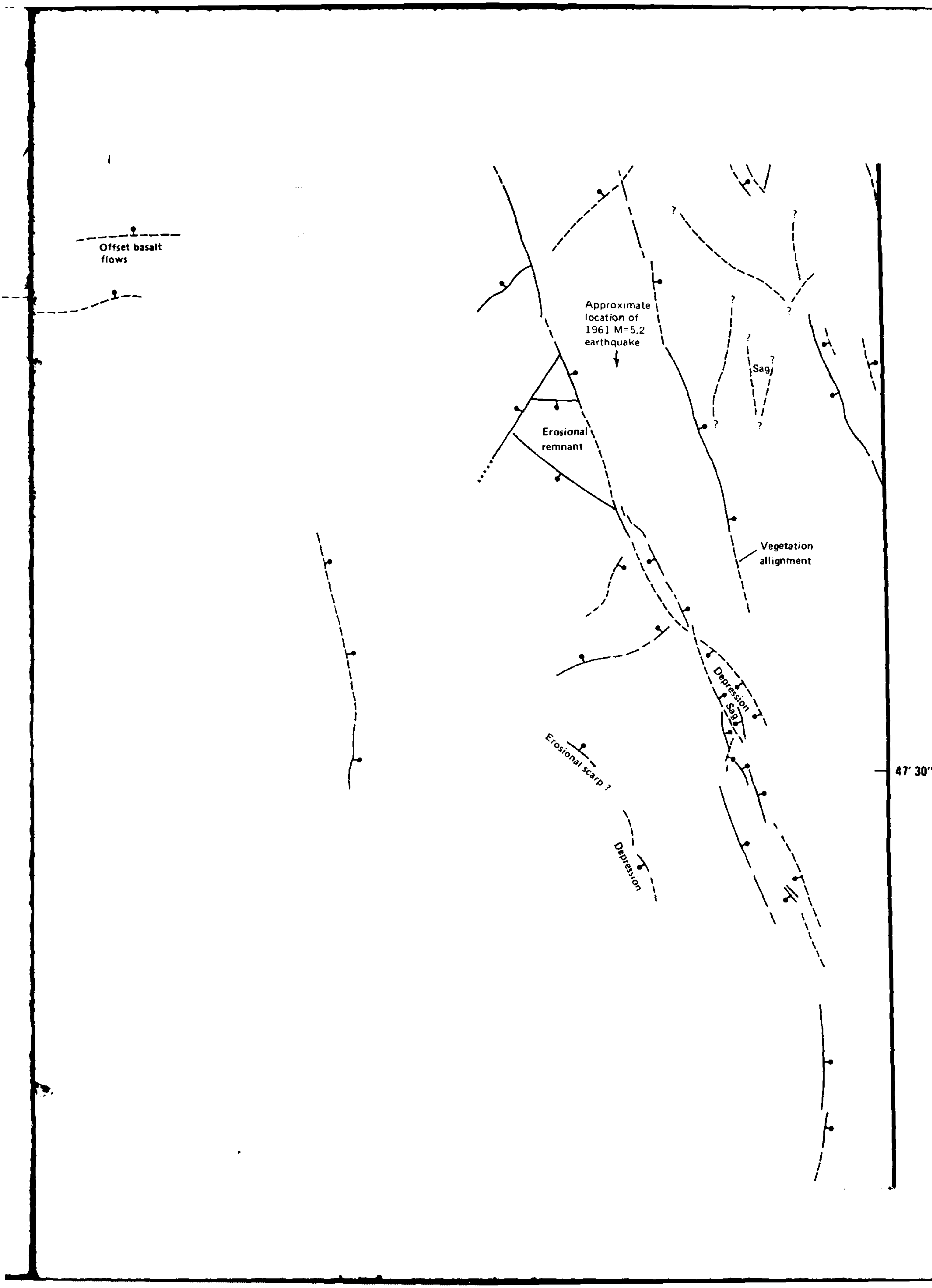

117° 52′ 30″
35° 52′ 30″
50′
Tension gash
Ridge
Depression
Graben
50′

PEARSONVILLE QUADRANGLE
CALIFORNIA – KERN CO



NWC ACTIVE


Graben
47′ 30″



FAULT MAP SERIES

35° 45′

117° 52′ 30″

50′

GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

SCALE 1:2

1 ½ 0

1000 0 1000 2000 3000

1 .5 0

CONTOUR INTERV

DATUM IS MEAN

TOPOGRAPHIC BASE FRO
SURVEY PEARSONVILLE,
QUADRANGLE 1982

CARTOGRAPHY BY

EXPLANA

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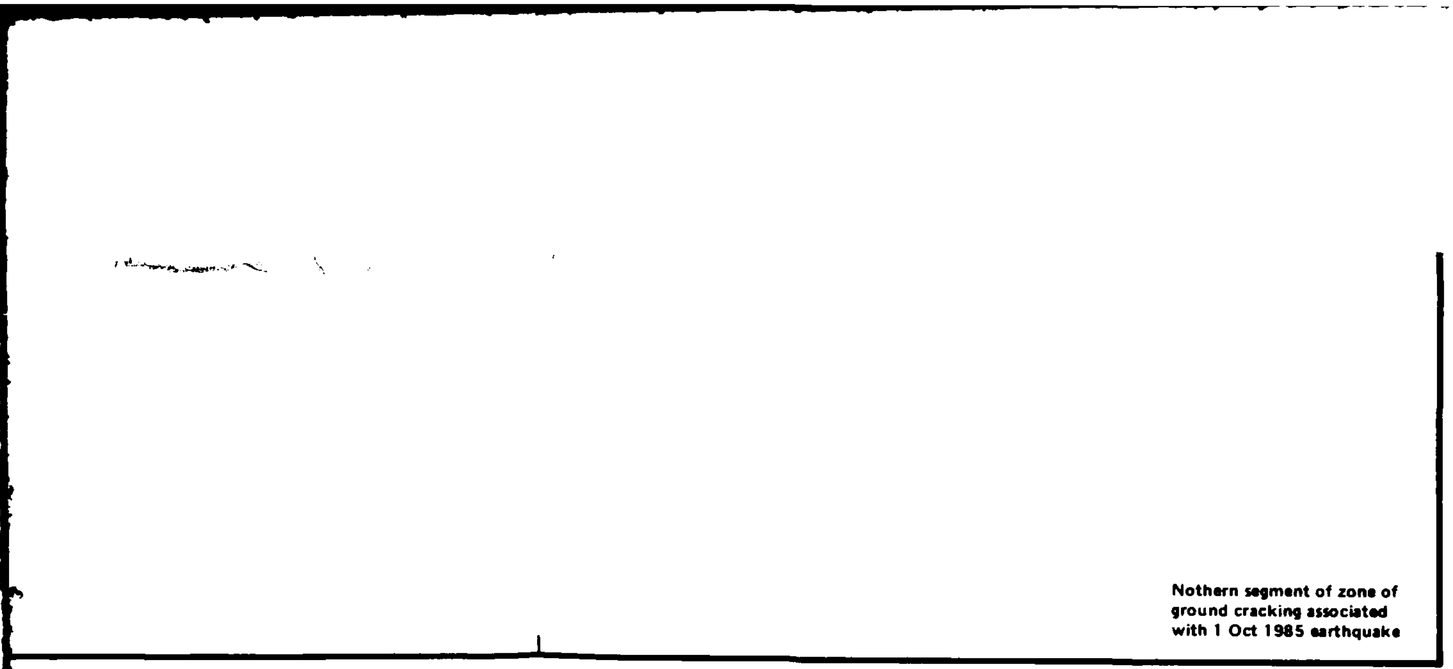
Fault trac

Solid line, field or photogeologic evidence scarps, trenches, sag ponds, or other surfa scars where noted; queried line, possibl interpretations not *excluded*, *dashed line* distinctive surficial features of faulting not active fault trace concealed by very rece regarded as approximatel, ball on down thr of *relative* motion

Other recently active breaks that have n features may be present

[1] The brief notes along the fault traces indicate locations clear. Fault trace features are not limited to these localitie the mapped fault lines

Pleistocene Lake



BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

0

4 000

1 MILE

4000 5000 6000 7000 FEET

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EV

1 KILOMETER

GEO ALS, 20 FEET

ORN SEA LEVEL

U.S. GEOLOGICAL

DEL ALIFORNIA 7.5'

P O'DELL

TION

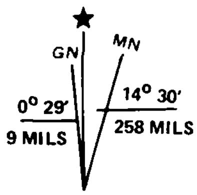
e

of recent movement shown by ce features,[1] including landslide e recent fault scarp, but other probable recent movement, but present, dotted line, potentially nt alluvium (position should be own side, arrows show direction

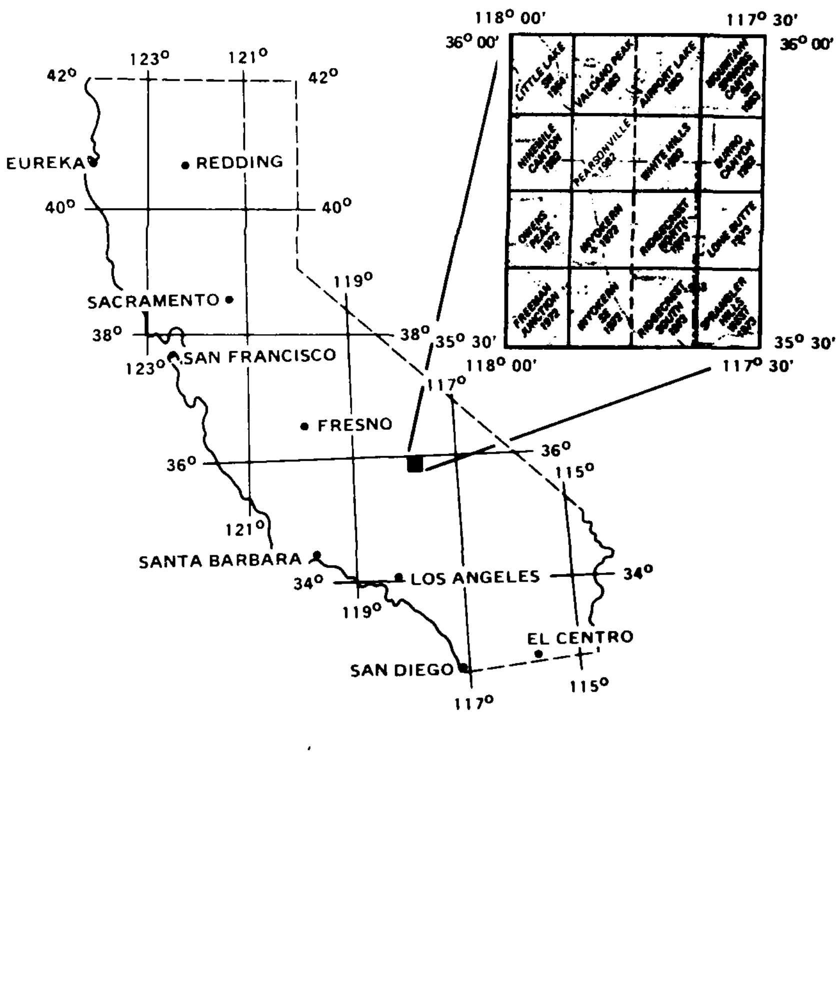
nt produced distinctive surficial

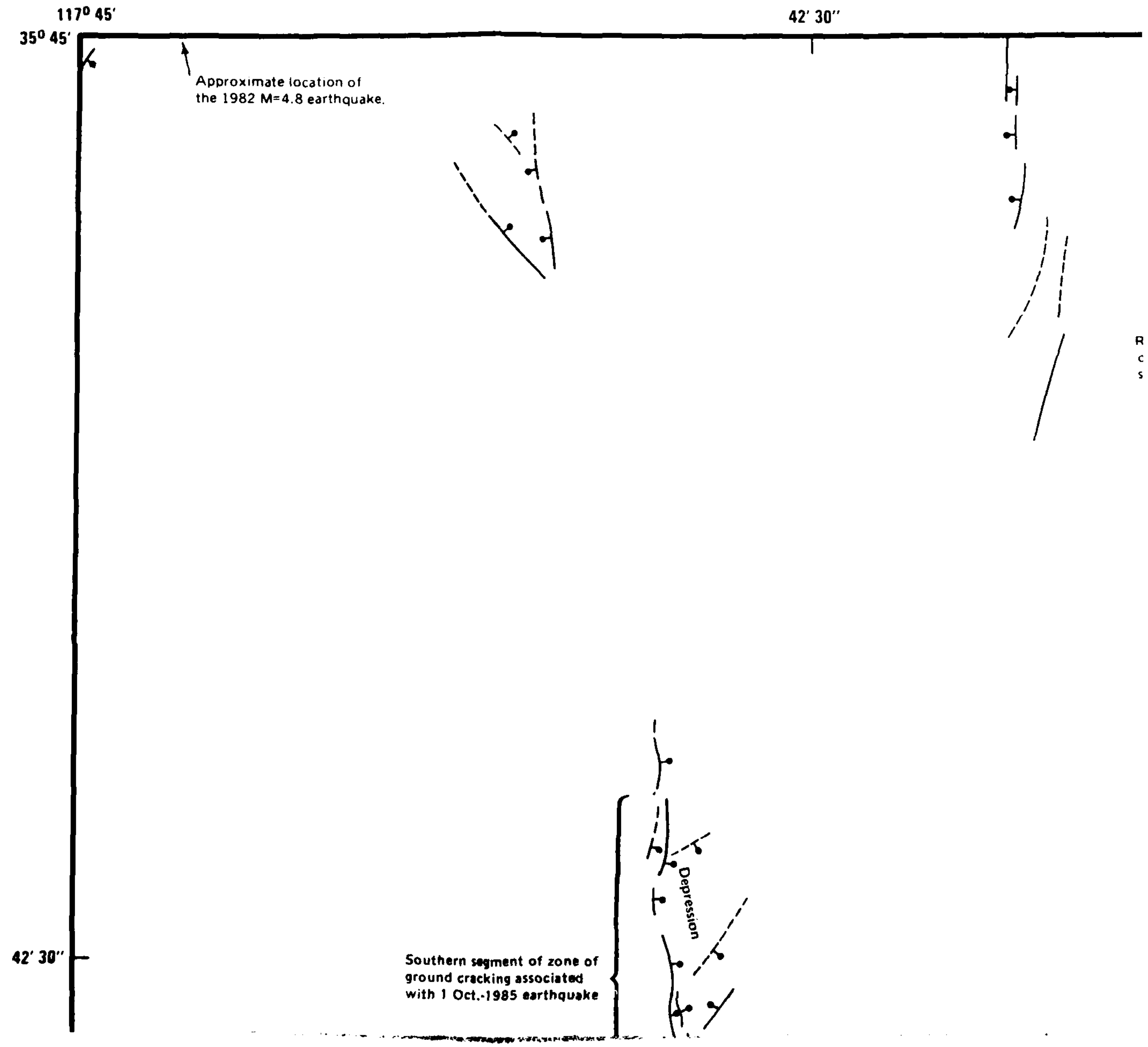
line ere the features mentioned are especially but are present to some degree all along

Shoreline



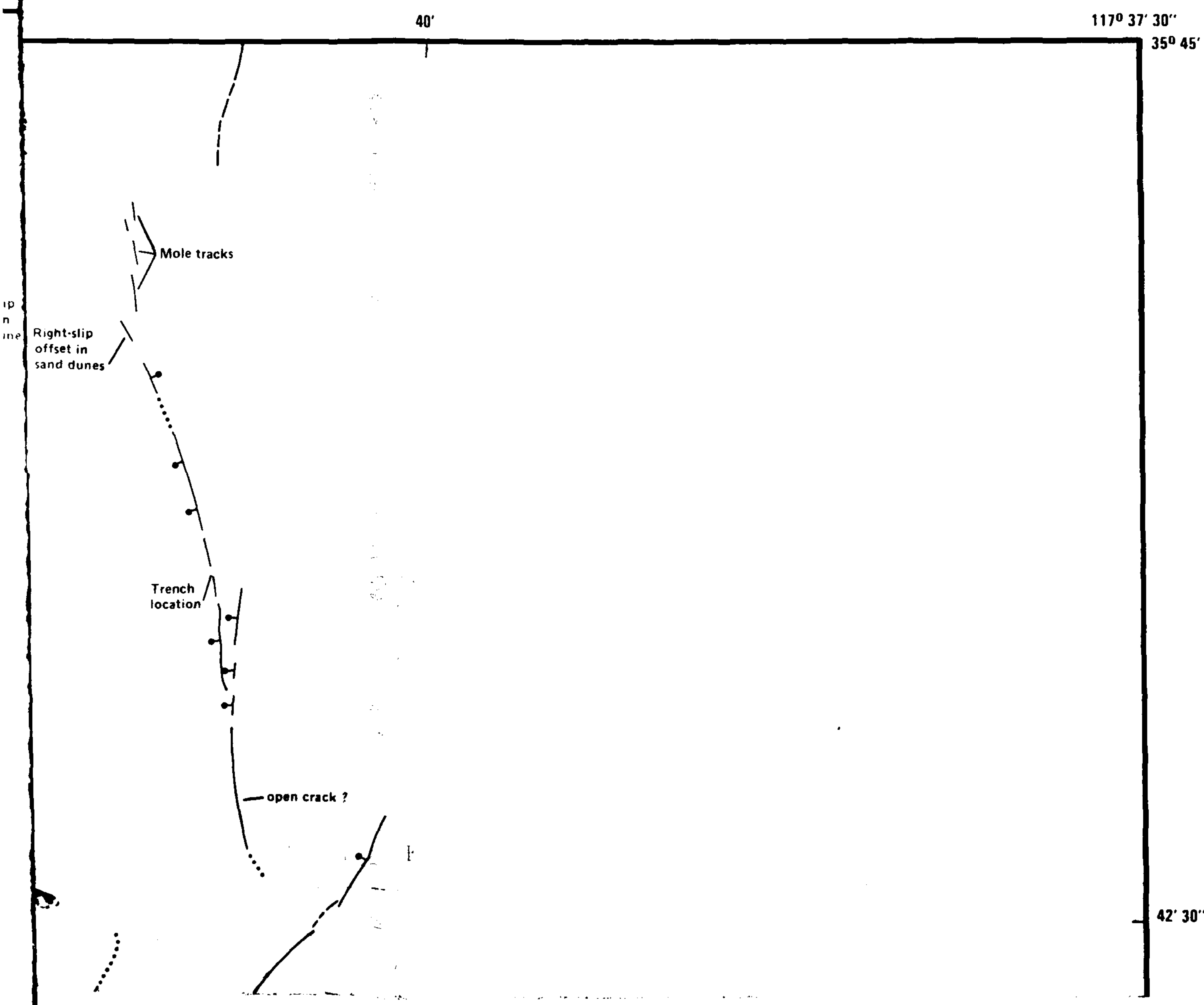
UTM GRID & 1980 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



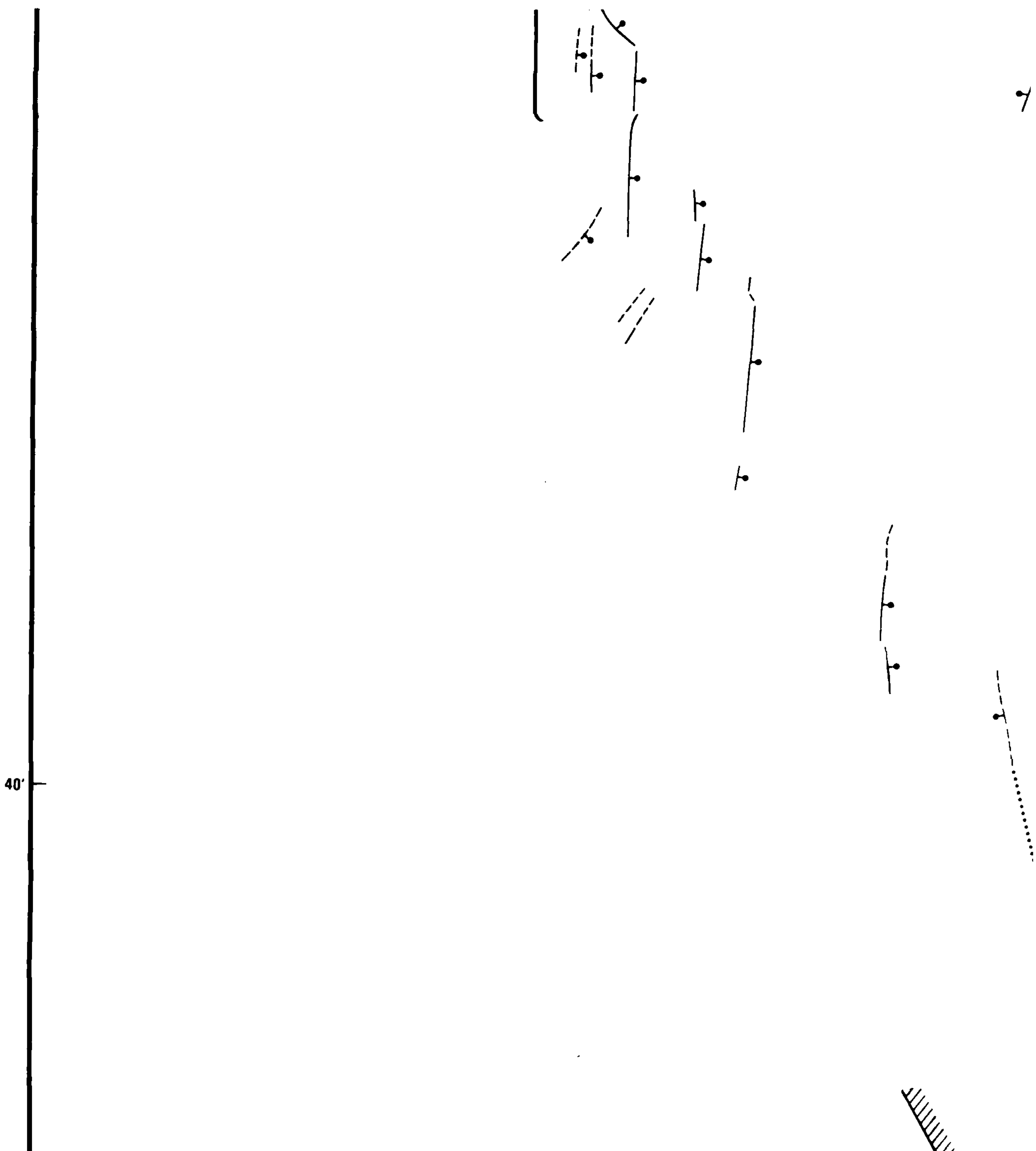


117° 45'
35° 45'
42' 30"
Approximate location of the 1982 M=4.8 earthquake.
Depression
42' 30"
Southern segment of zone of ground cracking associated with 1 Oct.-1985 earthquake

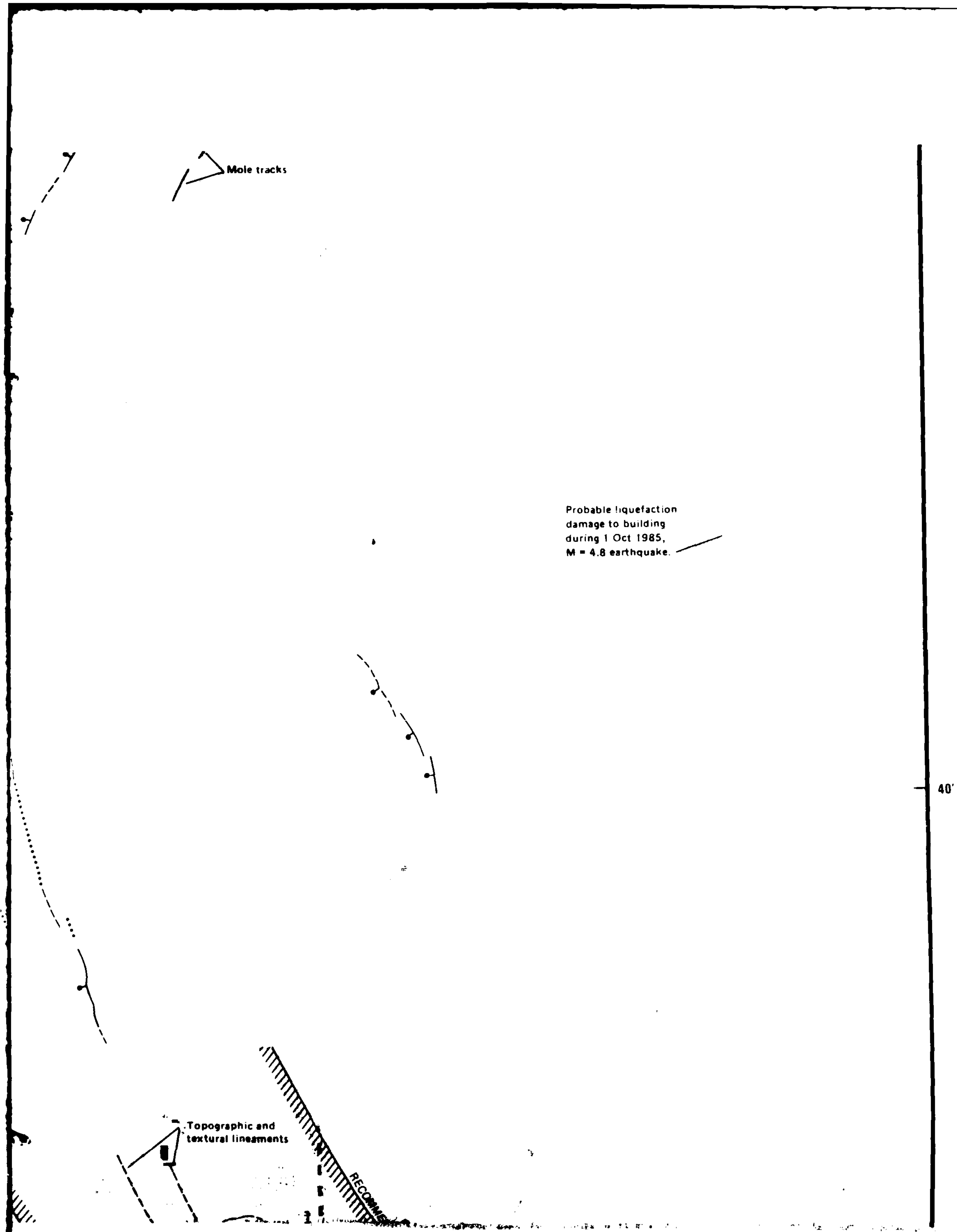
RIDGECREST NORTH QUADRANGLE
CALIFORNIA - KERN CO.



NWC ACTIVE



The recommended special studies zone contains the southern extension of the Little Lake fault. This fault was responsible for earthquakes with magnitudes of M ~ 5 in 1938, 1961 and 1982. Evidence of actively-occurring, tectonic deformation exists within the special studies zone. The extent and characteristics of this deformation could not be determined because of widespread alterations to the natural landscape by cultural activities. Consequently, detailed, site-specific, geologic studies designed to identify areas potentially subject to fault offset, severe ground shaking and earthquake- [illegible]



FAULT MAP SERIES

identify areas potentially subject to fault offset, severe ground shaking and earthquake-induced soil instability should be conducted prior to future development within this zone.

MENDED SPECIAL ST

35° 37′ 30″

117° 45′

42′ 30″

SCALE 1 24 000

1 ½ 0

1000 0 1000 2000 3000 4000

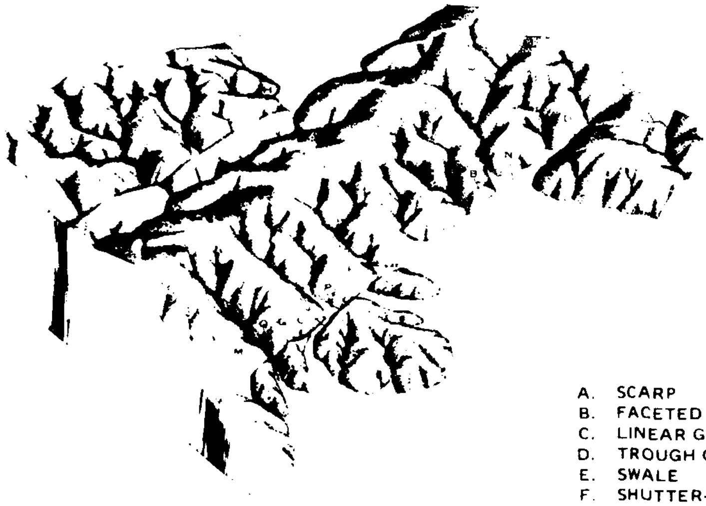
1 .5 0

CONTOUR INTERVALS 5 F

DATUM IS MEAN SEA LEV

TOPOGRAPHIC BASE FROM U S GE
SURVEY RIDGECREST NORTH, CA
7.5′QUADRANGLE 1973

CARTOGRAPHY BY P O'DE



GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

EXPLANATION

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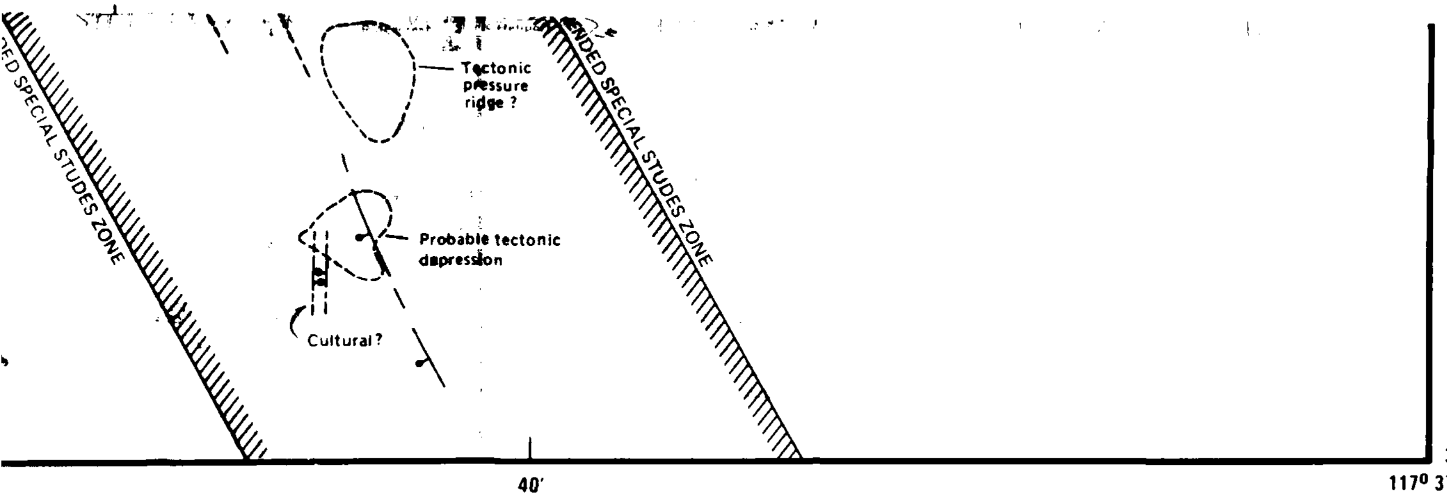
Fault trace

Solid line, field or photogeologic evidence of rece
scarps, trenches, sag ponds, or other surface featur
scars where noted; queried line possible recent
interpretations not excluded; dashed line probable
distinctive surficial features of faulting not present
active fault trace concealed by very recent alluviu
regarded as approximately ball on down thrown side
of relative motion

Other recently active breaks that have not produc
features may be present

* The brief notes along the fault traces indicate locations where the fea
clear. Fault trace features are not limited to these localities but are pres
the mapped fault lines

Pleistocene Lake Shoreline



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1 MILE

4000 5000 6000 7000 FEET

1 KILOMETER

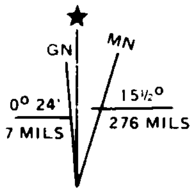
ALS, 5 FEET
SEA LEVEL

M U.S. GEOLOGICAL
RTH, CALIFORNIA

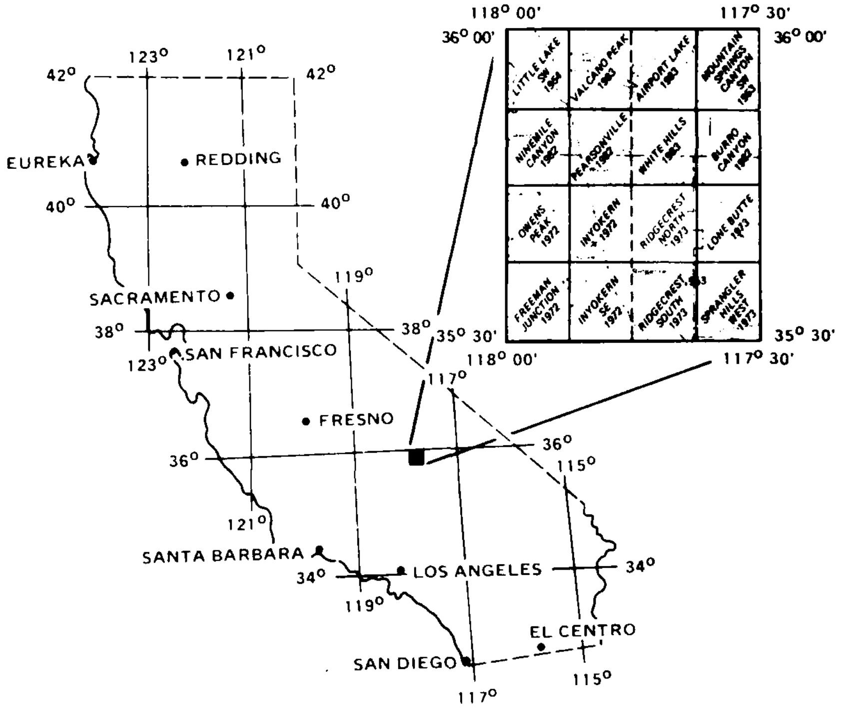
P. O'DELL

TION

BY G. R. ROQUEMORE,
J. T. ZELLMER 1986



UTM GRID & 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



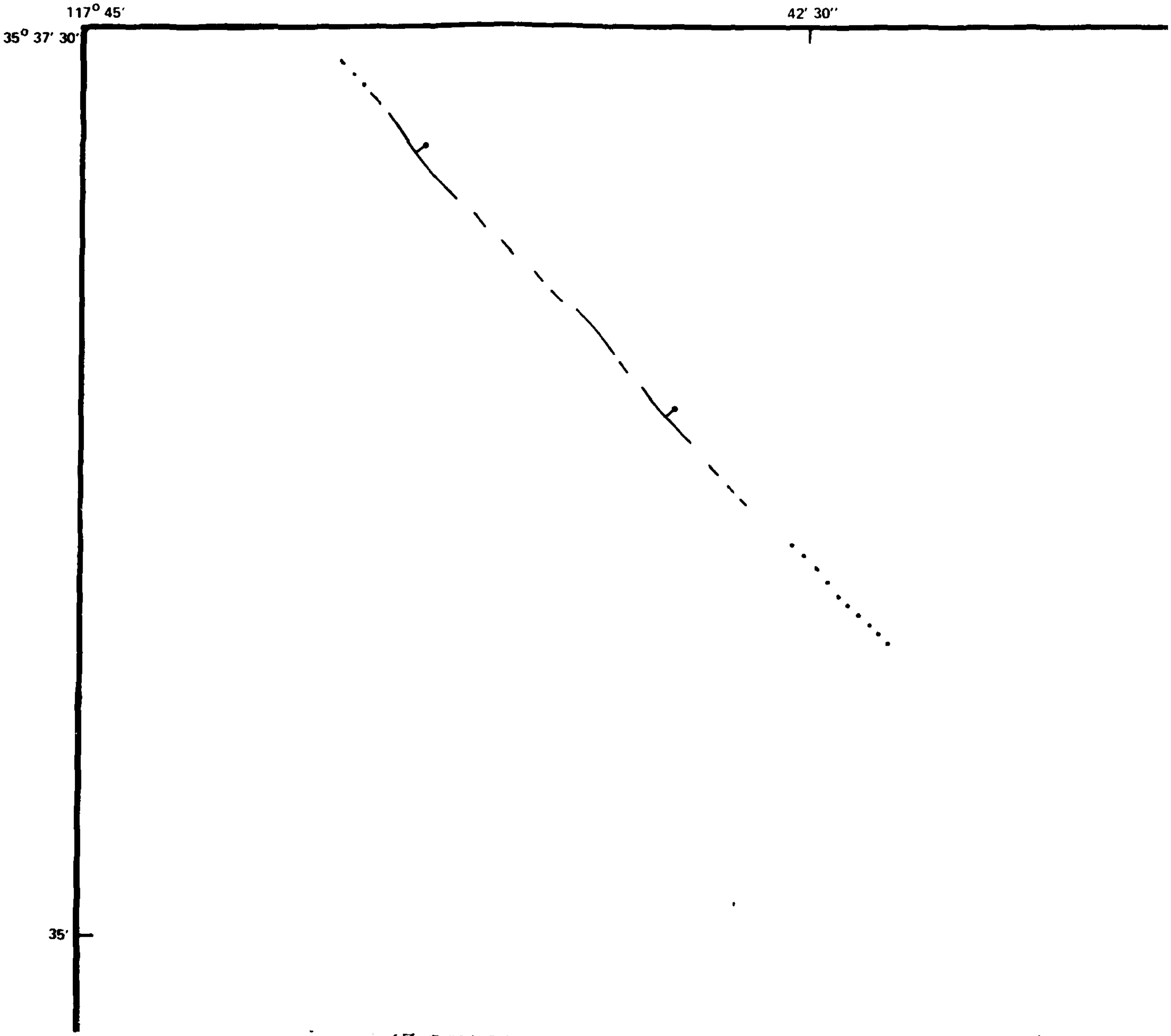
e

...of recent movement shown by ...e features[1] including landslide ...recent fault scarp, but other ...bable recent movement, but ...resent dotted line, potentially ...nt alluvium position should be ...wn side arrows show direction

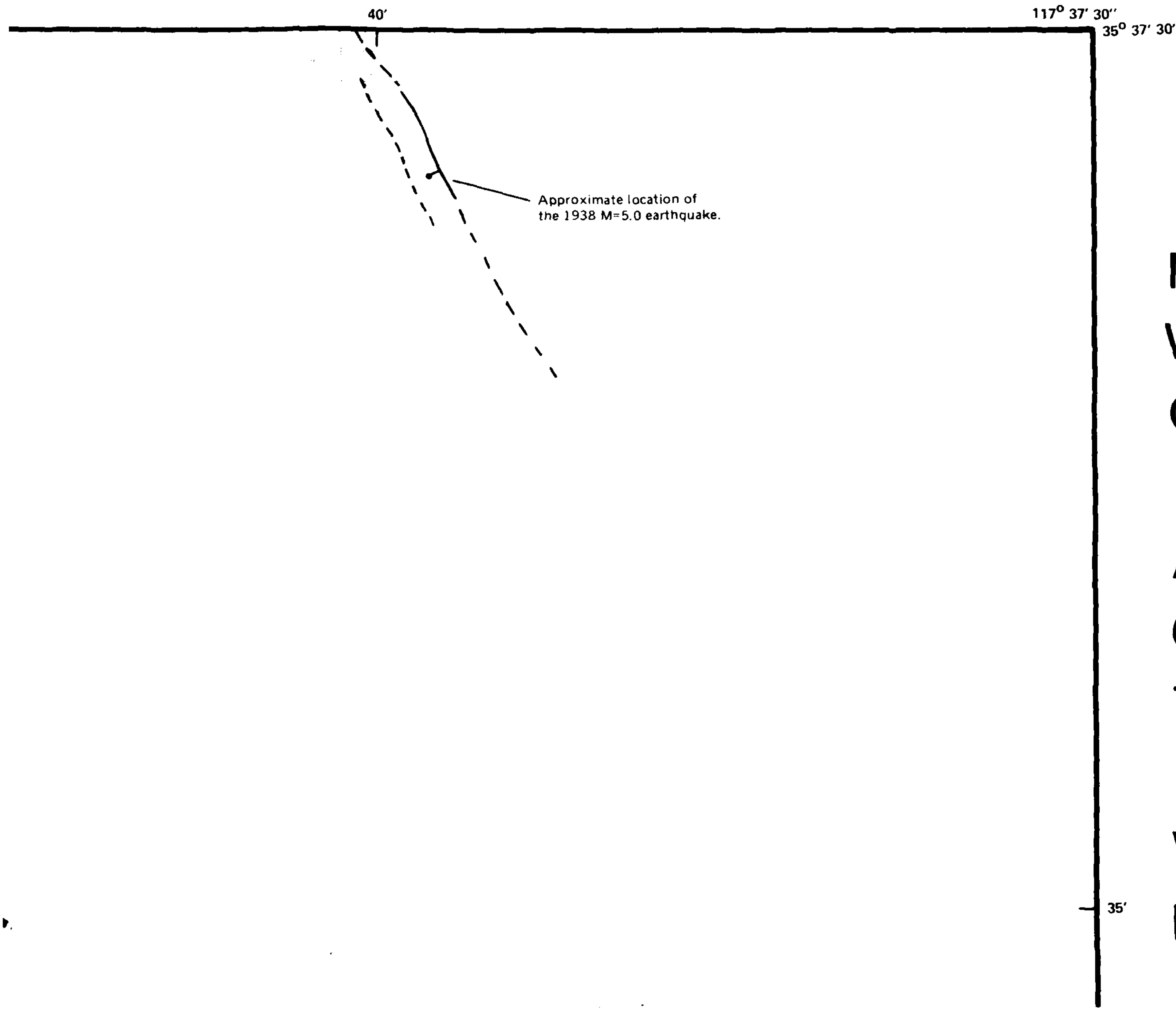
...produced distinctive surficial

...the features mentioned are especially ...are present to some degree all along

Shoreline


117° 45′
42′ 30″
35° 37′ 30″
35′

RIDGECREST SOUTH QUADRANGLE
CALIFORNIA - KERN CO.



NWC ACTIVE

32′ 30″

32′ 30″

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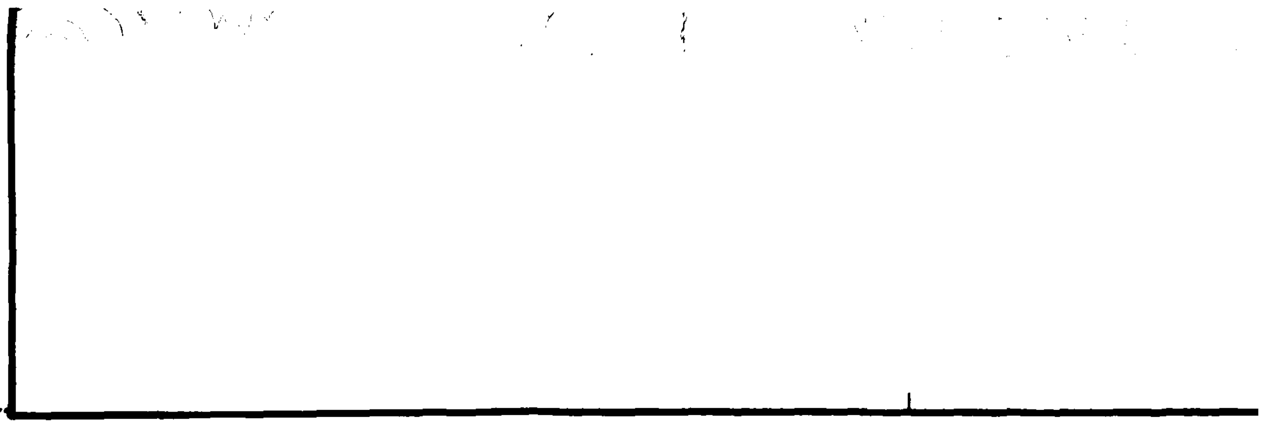
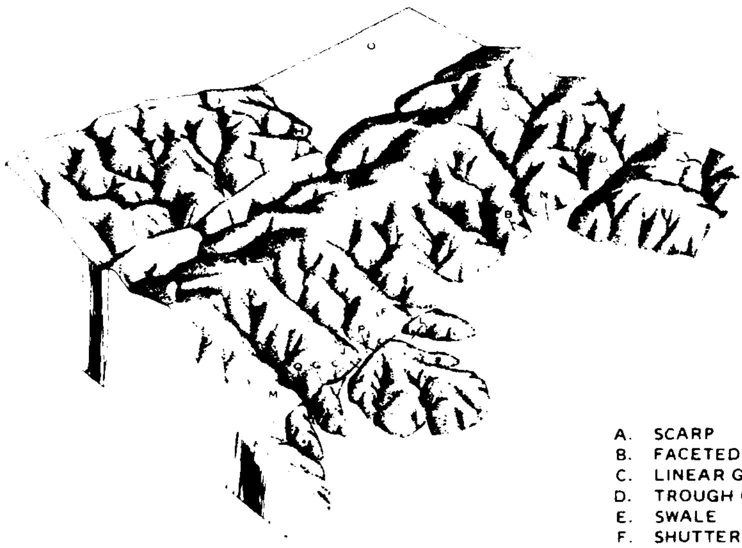


35° 30′
117° 45′



GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
G. NOTCH
H. TRENCH
I. BENCH
J. OFFSET DRAINAGE CHANNEL
K. DEFLECTED DRAINAGE CHANNEL
L. BEHEADED DRAINAGE CHANNEL
M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

SCALE 1

1 ½ 0

1000 0 1000 2000 30(

1 5 0

CONTOUR INTE

DATUM IS MEA

TOPOGRAPHIC BASE FR
SURVEY RIDGECREST S
7.5′QUADRANGLE 1973

CARTOGRAPHY I

EXPLANA

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Fault tr

Solid line, field or photogeologic eviden scarps, trenches, sag ponds, or other su scars where noted, queried line, possi interpretations not excluded, dashed lin distinctive surficial features of faulting n active fault trace concealed by very re regarded as approximate); ball on down t of relative motion

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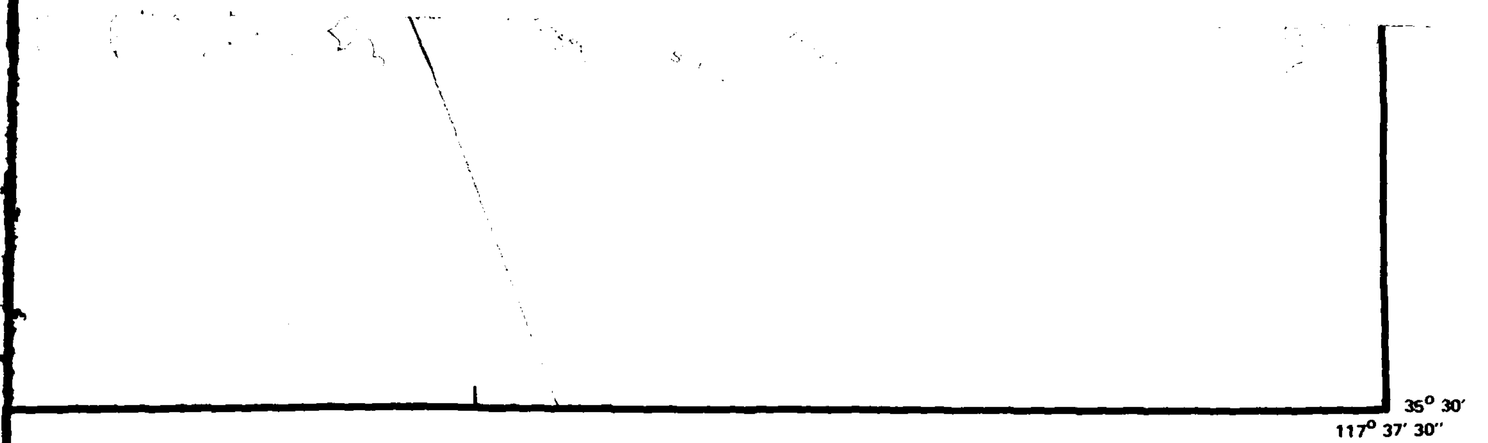
Pleistocene Lake



)0
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1 MILE
5000 6000 7000 FEET

1 KILOMETER

FEET

EOLOGICAL
ALIFORNIA

ELL

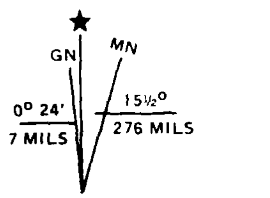
...nt movement shown by ...ures [1] including landslide ...t fault scarp, but other ...e recent movement, but ...t dotted line, potentially ...vium position should be ...le arrows show direction

...uced distinctive surficial

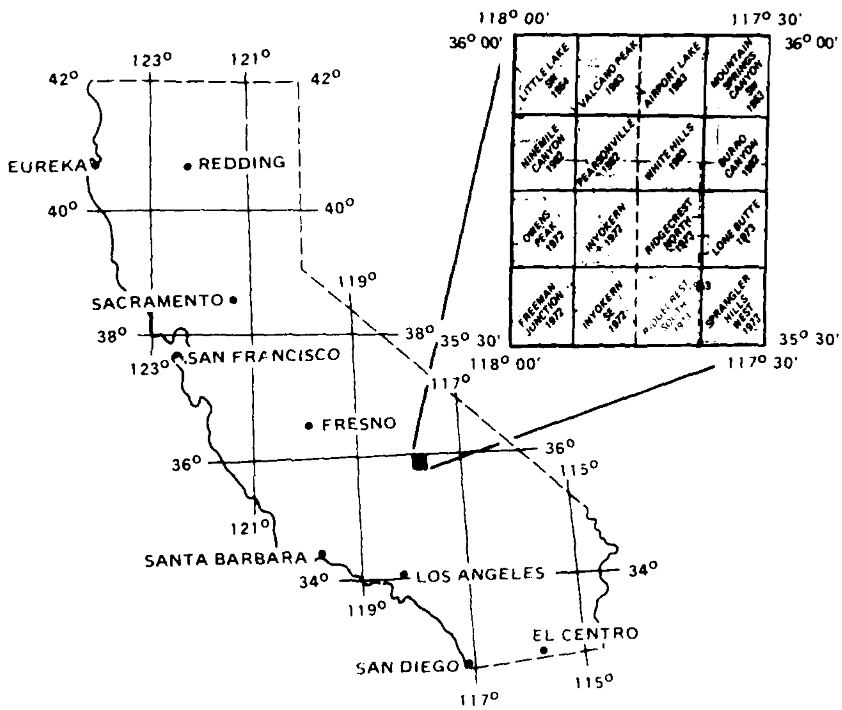
...features mentioned are especially ...resent to some degree all along

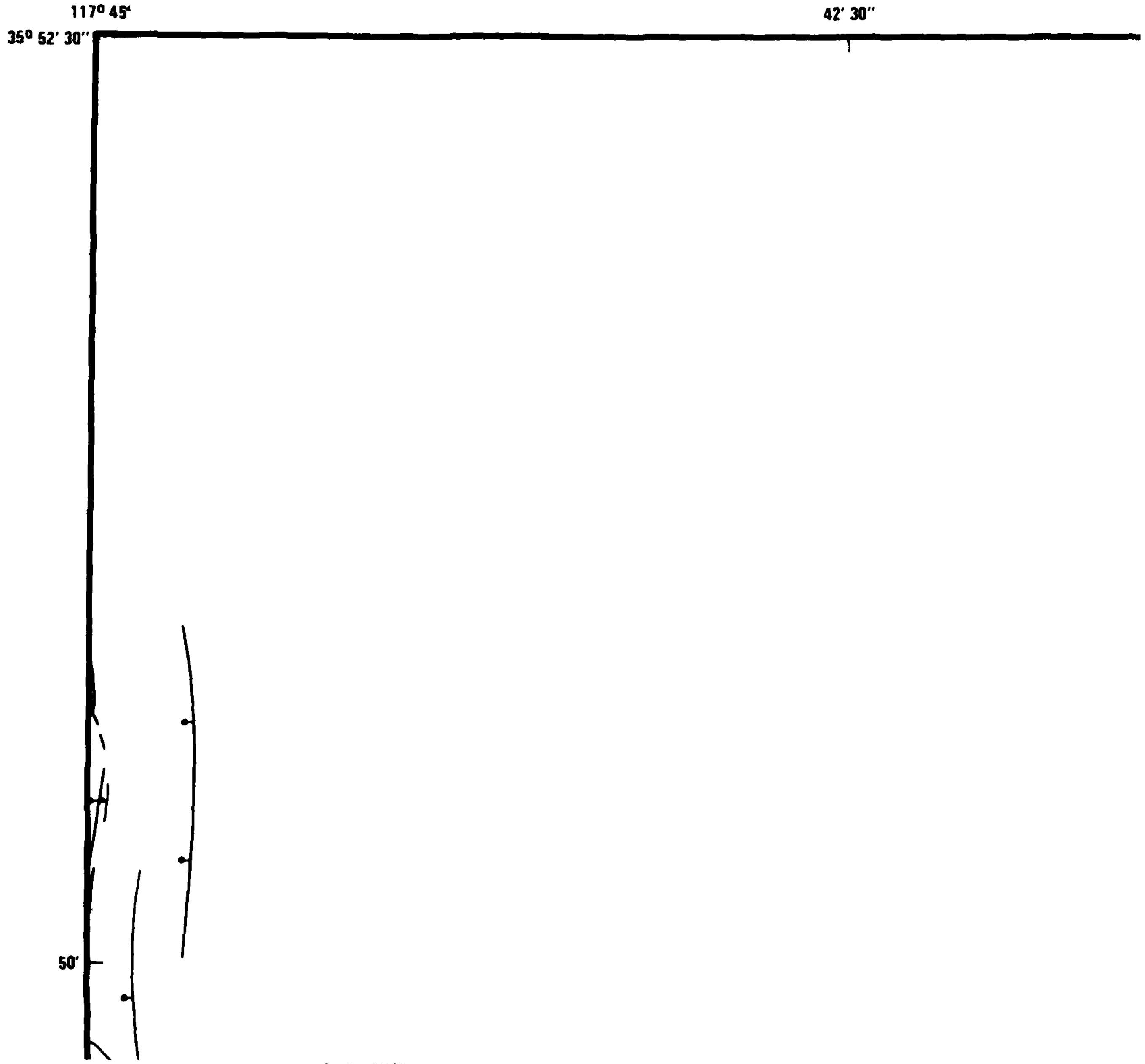
...line

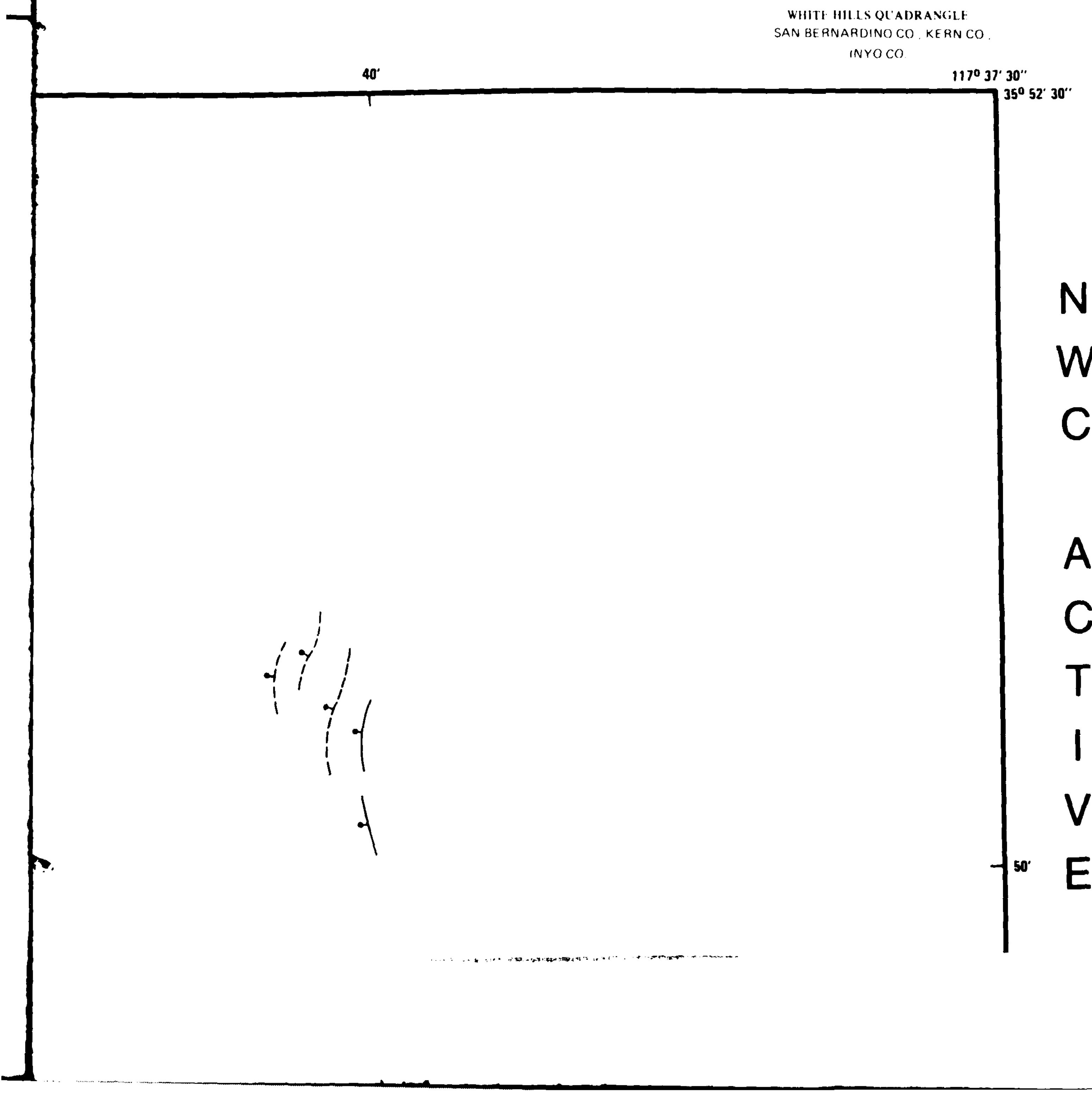
BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

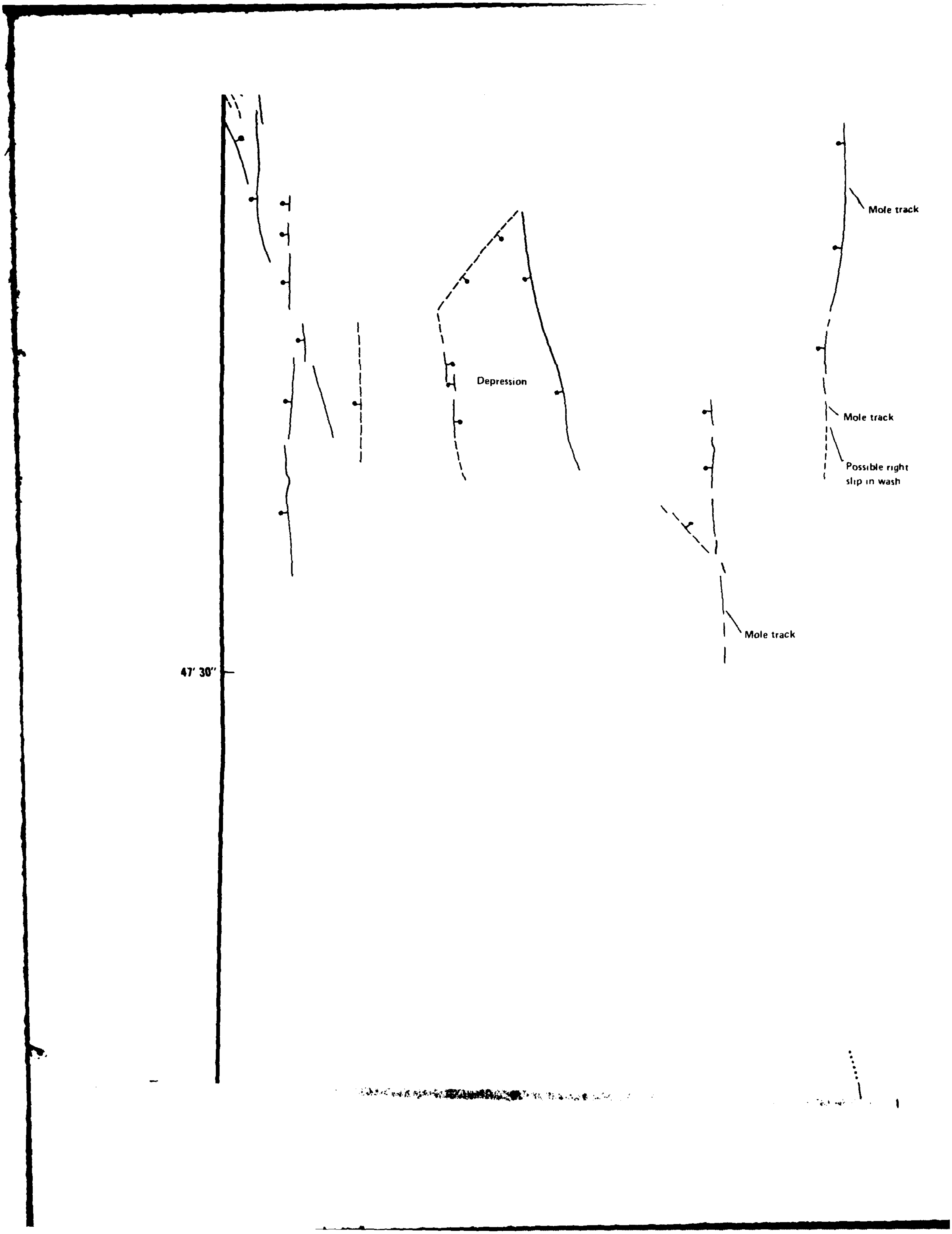


UTM GRID & 1973 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

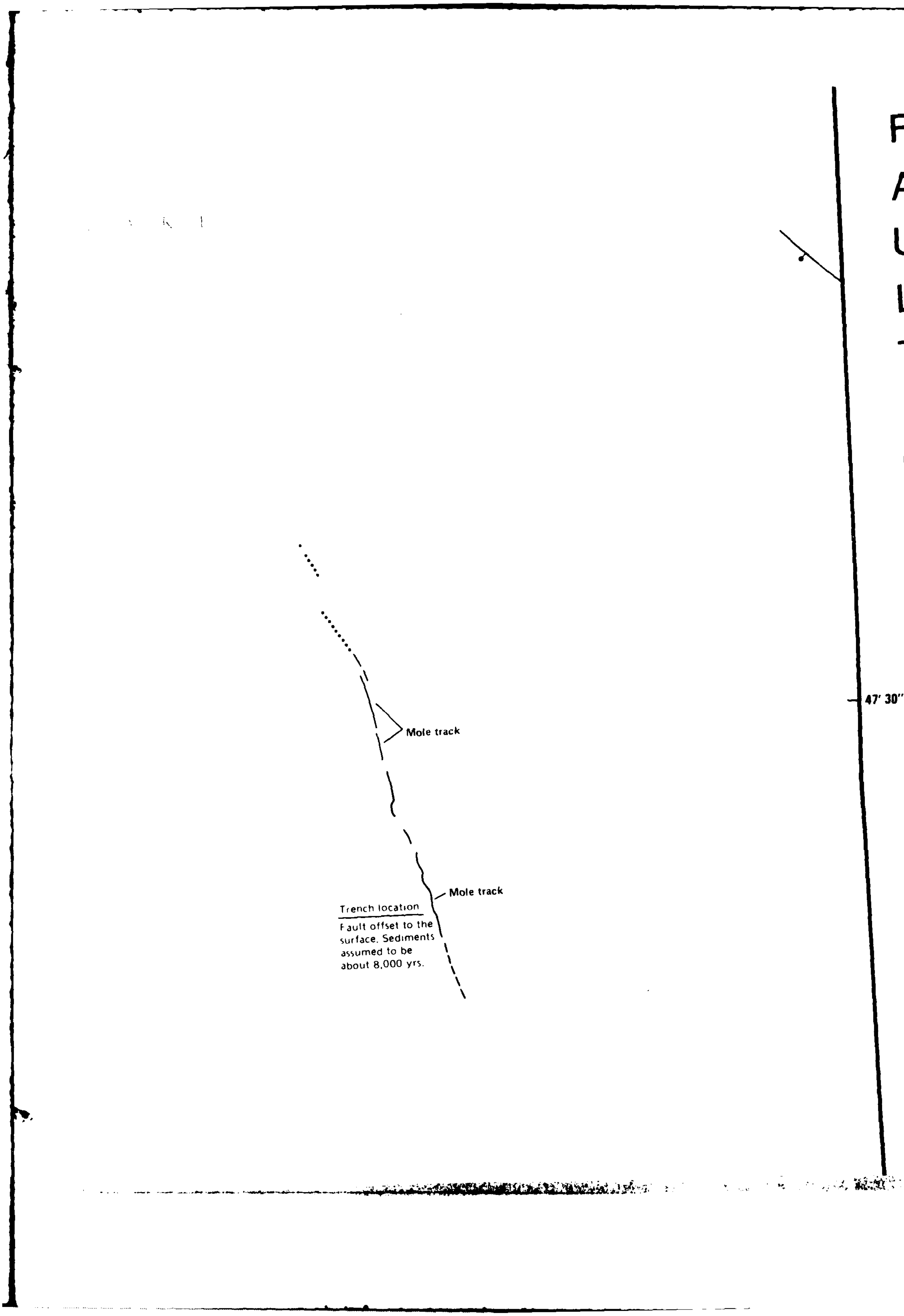



117° 45'
42' 30"
35° 52' 30"
50'

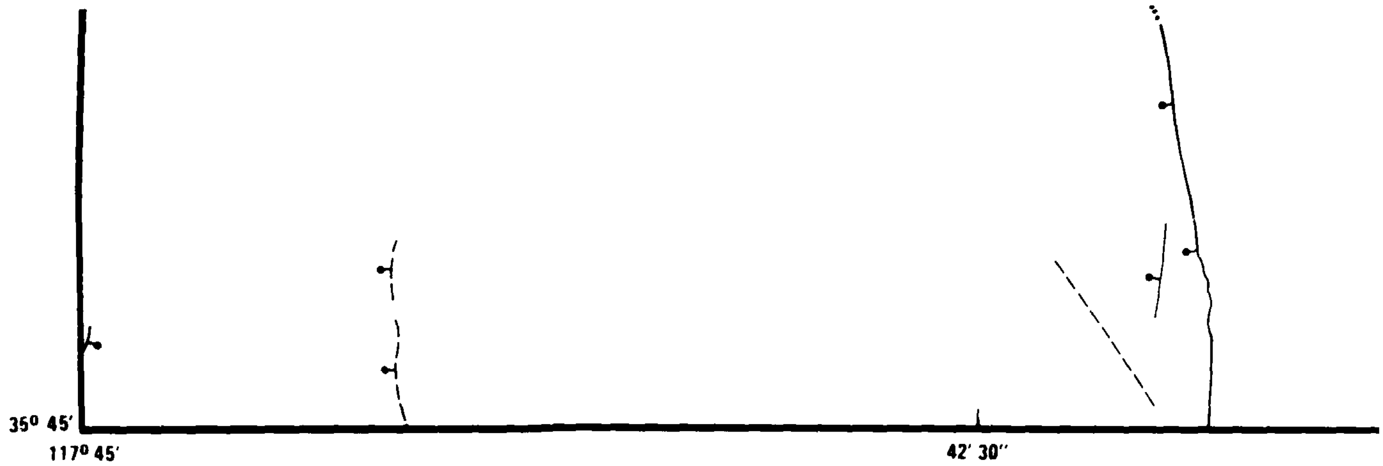

WHITE HILLS QUADRANGLE
SAN BERNARDINO CO., KERN CO.,
INYO CO.
40'
117° 37' 30"
35° 52' 30"
50'
NWC ACTIVE



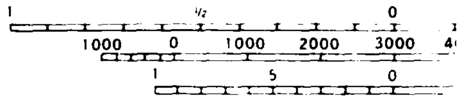
Mole track
Depression
Mole track
Possible right
slip in wash
Mole track
47′ 30″



FAULT MAP SERIES



SCALE 1 24 00



CONTOUR INTERVAL

DATUM IS MEAN SEA

TOPOGRAPHIC BASE FROM U S

SURVEY WHITE HILLS CALIFOR

QUADRANGLE 1983

CARTOGRAPHY BY P

GENERALIZED DIAGRAM OF FAULT FEATURES

A. SCARP
B. FACETED RIDGE
C. LINEAR GULLY
D. TROUGH OR LINEAR CANYON
E. SWALE
F. SHUTTER-RIDGE SCARP
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M. BEHEADED DRAINAGE CHANNEL WITH ALLUVIAL RAMP
N. SAG POND
O. DEPRESSION (PLAYA BASIN)
P. PONDED ALLUVIUM
Q. SPRING

EXPLANATIO

?

Fault trace

Solid line field or photogeologic evidence of scarps trenches sag ponds or other surface f scars where noted queried line possible re interpretations not excluded dashed line prob distinctive surficial features of faulting not pres active fault trace concealed by very recent a regarded as approximate ball on down thrown of relative motion

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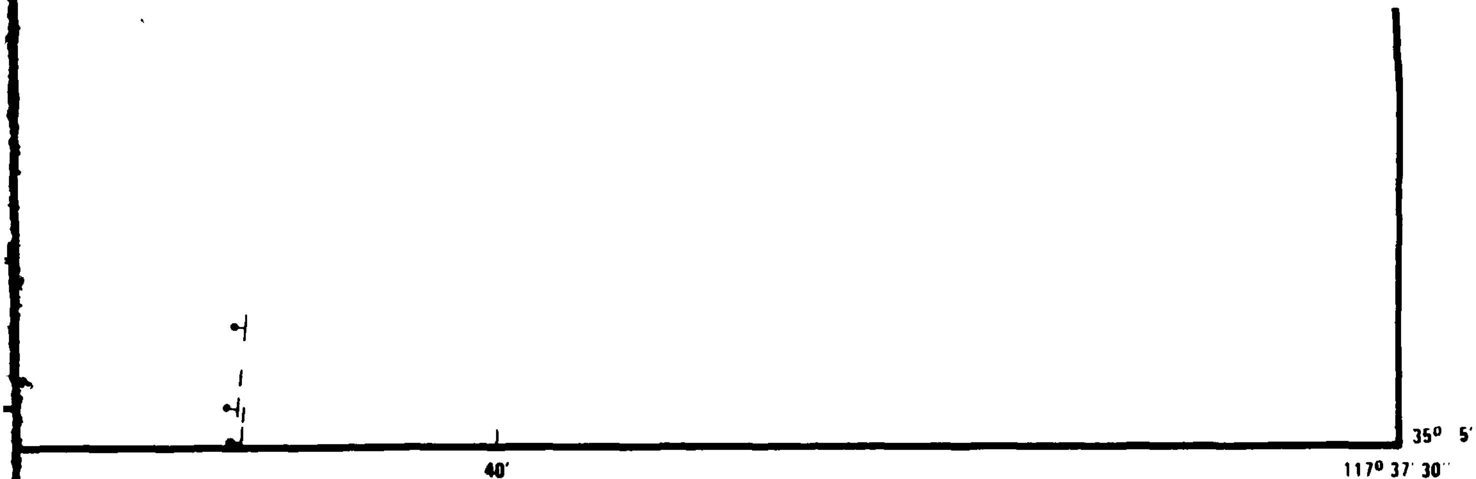
The brief notes along the fault traces indicate ... Fault trace features are ... these ... the mapped fault lines

Pleistocene Lake Shor



BY G. R. ROQUEMORE,
J. T. ZELLMER 1986

1 MILE

0 5000 6000 7000 FEET

1 KILOMETER

) FEET
EVEL

LOGICAL

A 7.5

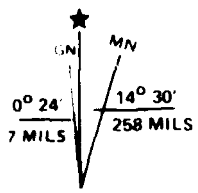
FEET

.....

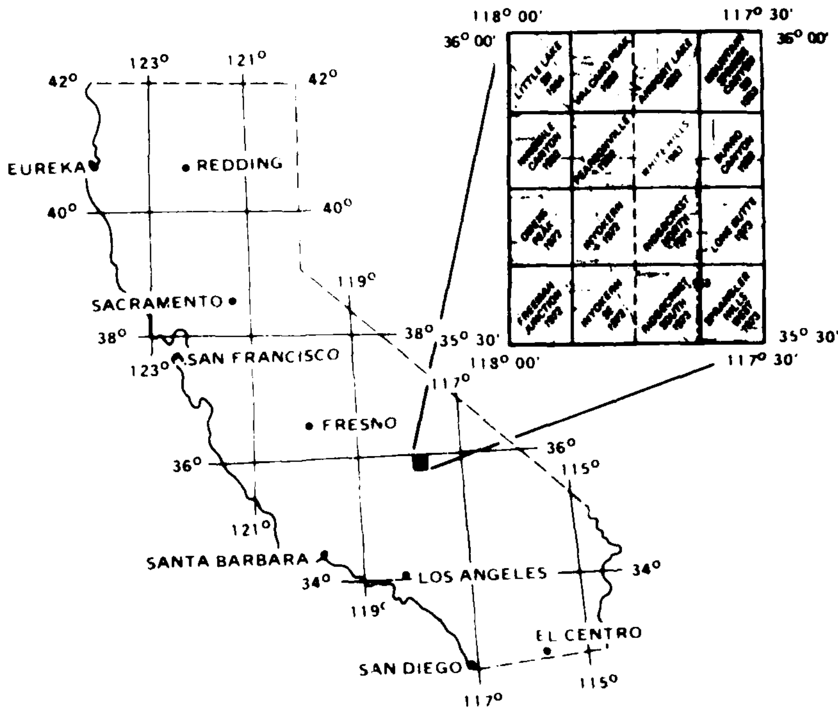
...ent movement shown by
...res including landslide
... fault scarp but other
... recent movement but
... dotted line potentially
... position should be
... arrows show direction

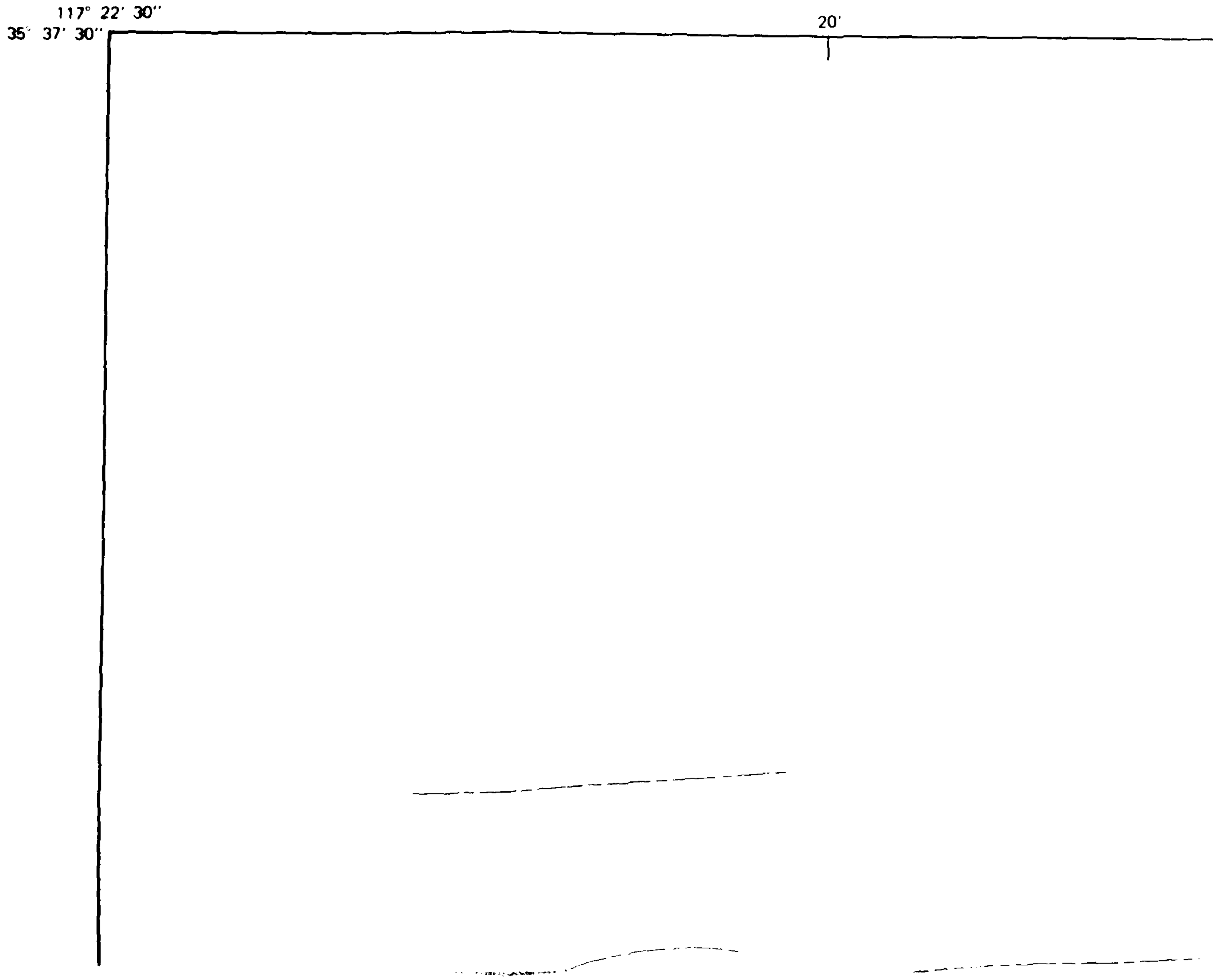
...ed distinctive surficial

... features mentioned are especially
... some degree all along



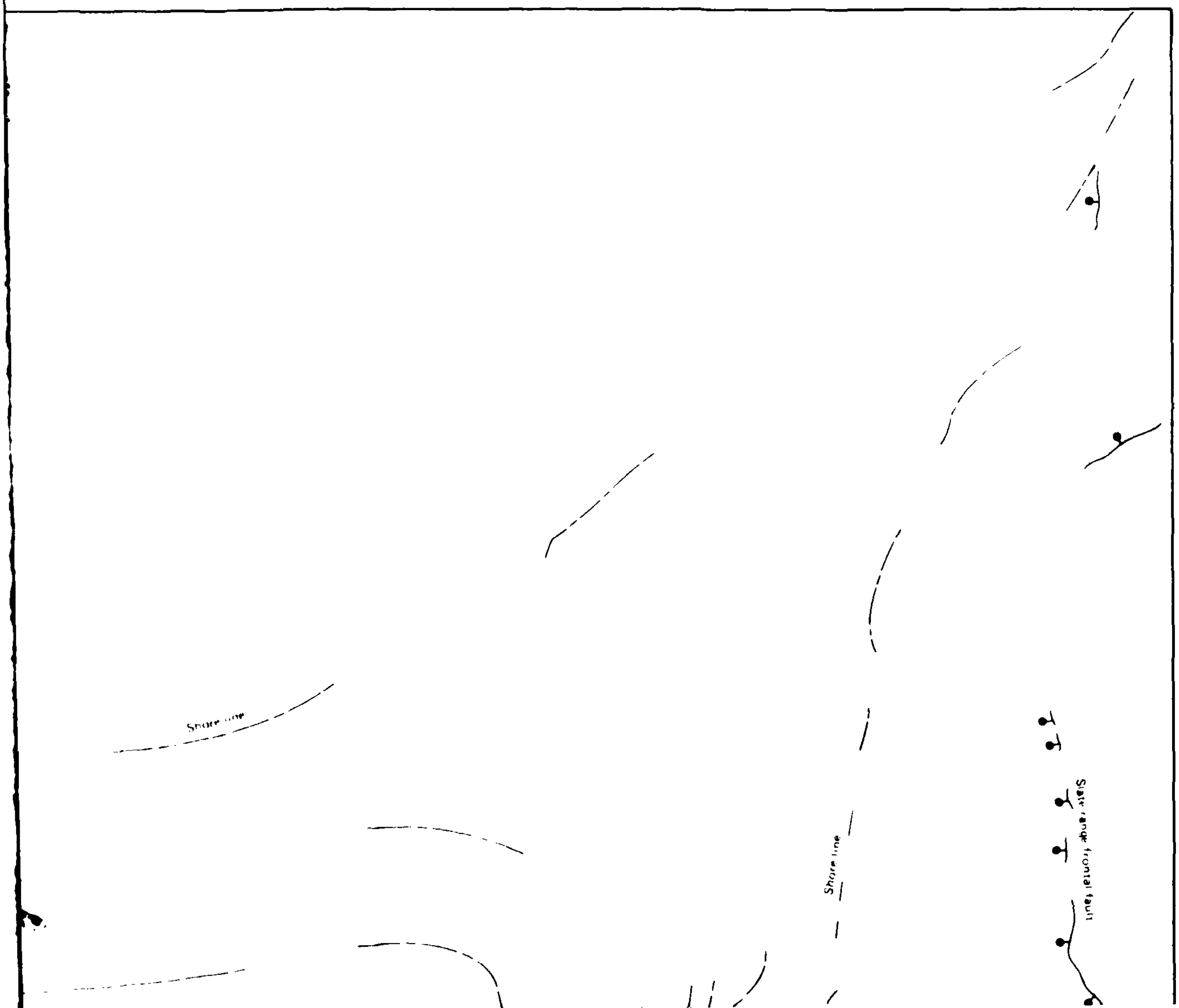
UTM GRID & 1980 MAGNETIC NORTH




117° 22′ 30″
35° 37′ 30″
20′

CHRISTMAS CANYON QUADRANGLE
CALIFORNIA SAN BERNARDINO CO

117 15′
35 37′ 30″



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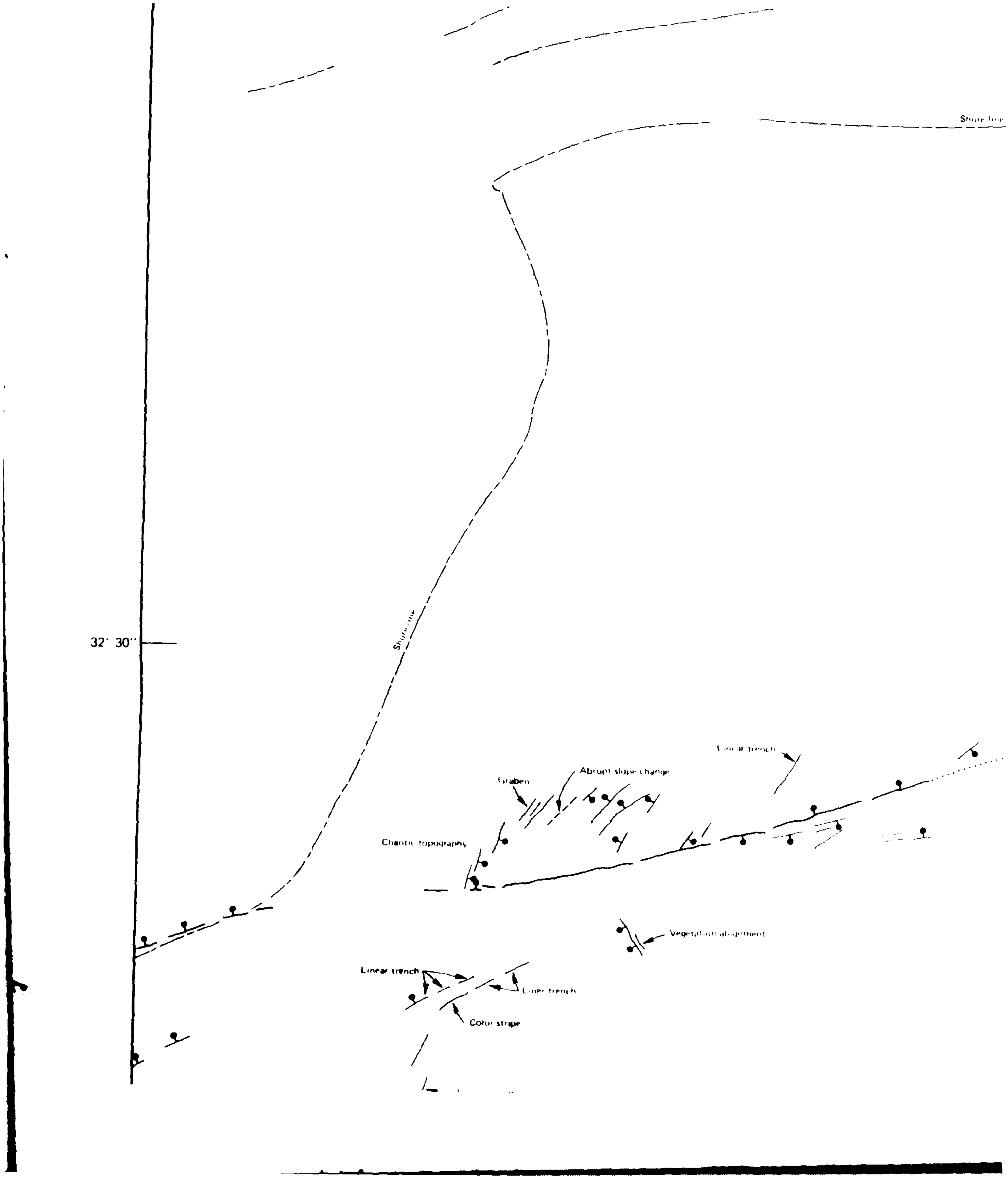
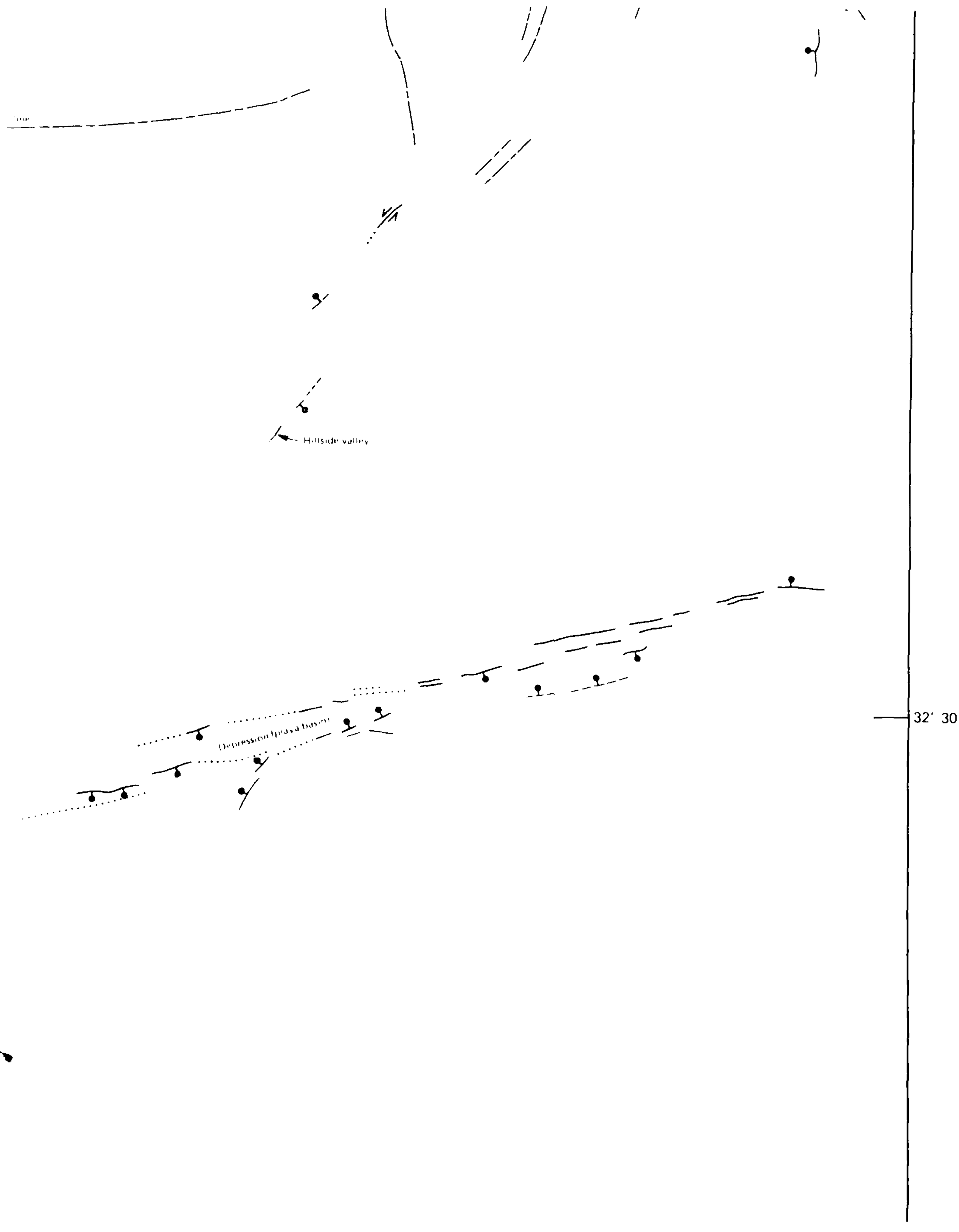
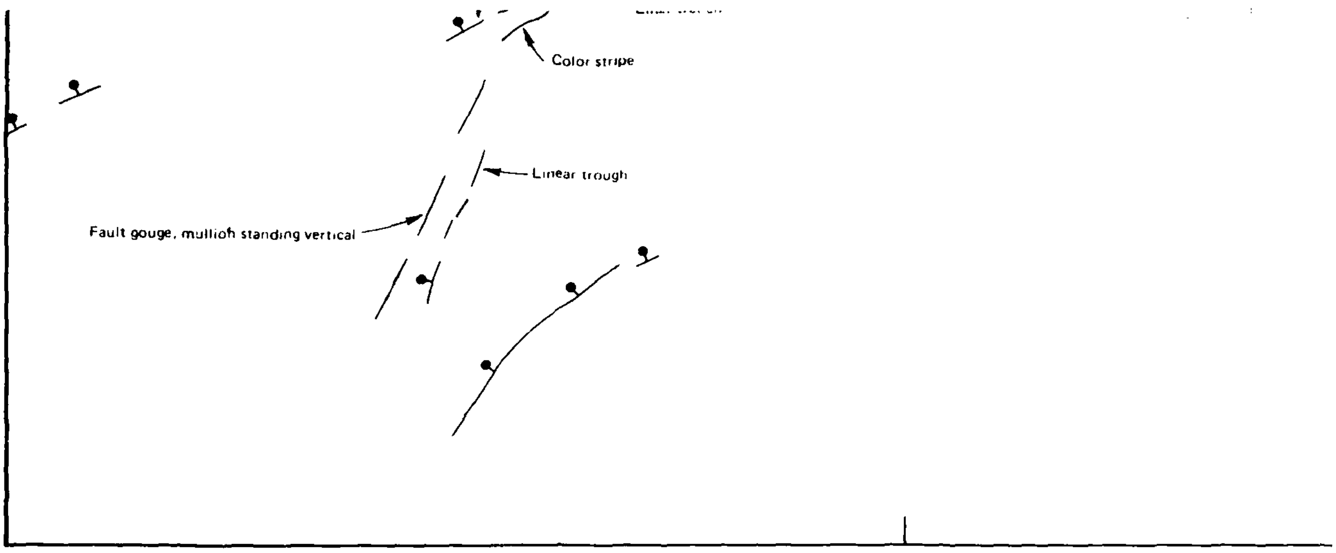

Shore line
32' 30''
Shoreline
Linear trench
Abrupt slope change
Graben
Chaotic topography
Vegetation alignment
Linear trench
Color stripe



ACTIVE FAULT MAP SER



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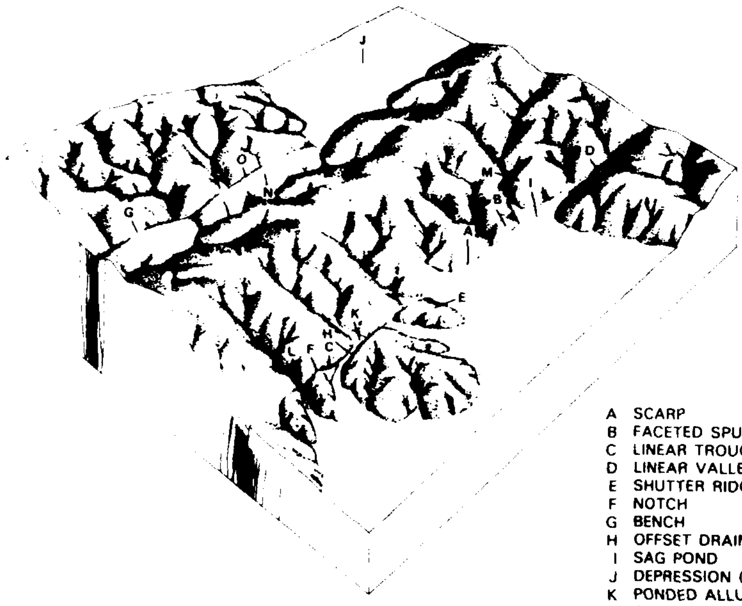
CONTOUR INTERVALS,
DATUM IS MEAN SEA

TOPOGRAPHIC BASE FROM U
SURVEY CHRISTMAS CANYOI
7½ QUADRANGLE 1973

CARTOGRAPHY BY P



A SCARP
B FACETED SPUR
C LINEAR TROUGH
D LINEAR VALLEY
E SHUTTER RIDGE
F NOTCH
G BENCH
H OFFSET DRAINAGE CHANNEL
I SAG POND
J DEPRESSION (PLAYA BASIN)
K PONDED ALLUVIUM
L SPRING
M OFFSET RIDGE
N LINEAR RIDGE
O HILLSIDE VALLEY

GENERALIZED DIAGRAM OF FAULT FEATURES

EXPLANATIC

? —

Fault trace

Solid line, field or photogeologic evidence o
scarps, trenches, sag ponds, or other surface
scars where noted; queried line, possible
interpretations not excluded, dashed line, pr
distinctive surficial features of faulting not p
active fault trace concealed by very recent
regarded as approximate); ball on down throw
of relative motion.

Other recently active breaks that have not
features may be present.

[1] The brief notes along the fault traces indicate locations whe
clear. Fault trace features are not limited to these localities b
the mapped fault lines.

Pleistocene Lake Sh(

REFERENCES:

Clark, M. M., Map Showing Recently Active Breaks along the Garlock and Associated Faults, California. Miscellaneous Geologic Investigation Map I-741, scale 1:24 000, 1973, U.S. Geological Survey, Washington, D.C.

E
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35° 30′
117° 15′

5000

1 MILE

000 6000 7000 FEET

1 KILOMETRE

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movemen
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fault scar
recent mo movement shown by
dotted lin ,[1] including landslide
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arrows sh cent movement, but
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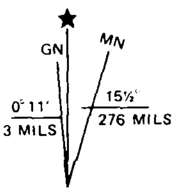
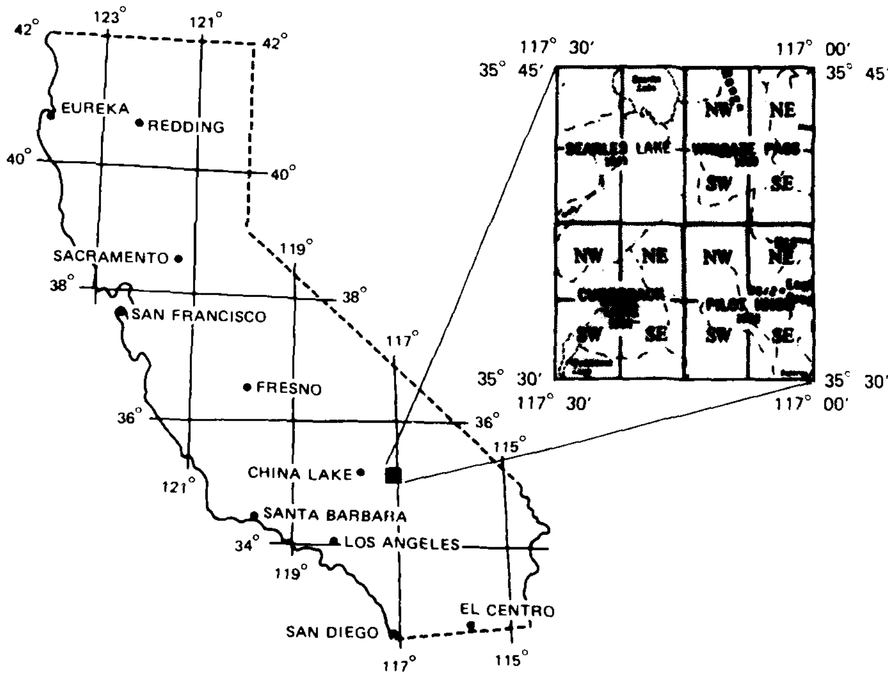
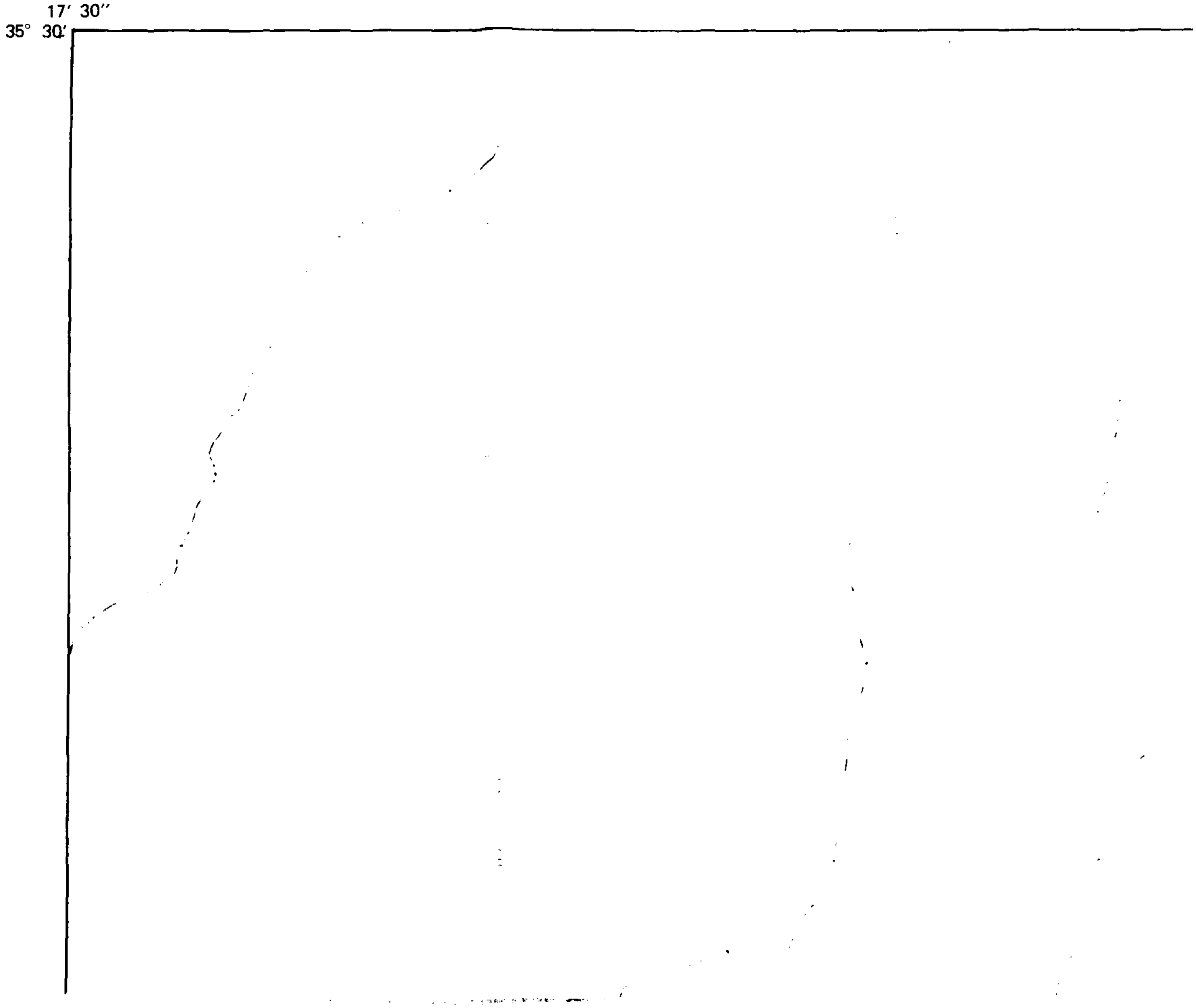


UTM GRID & 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

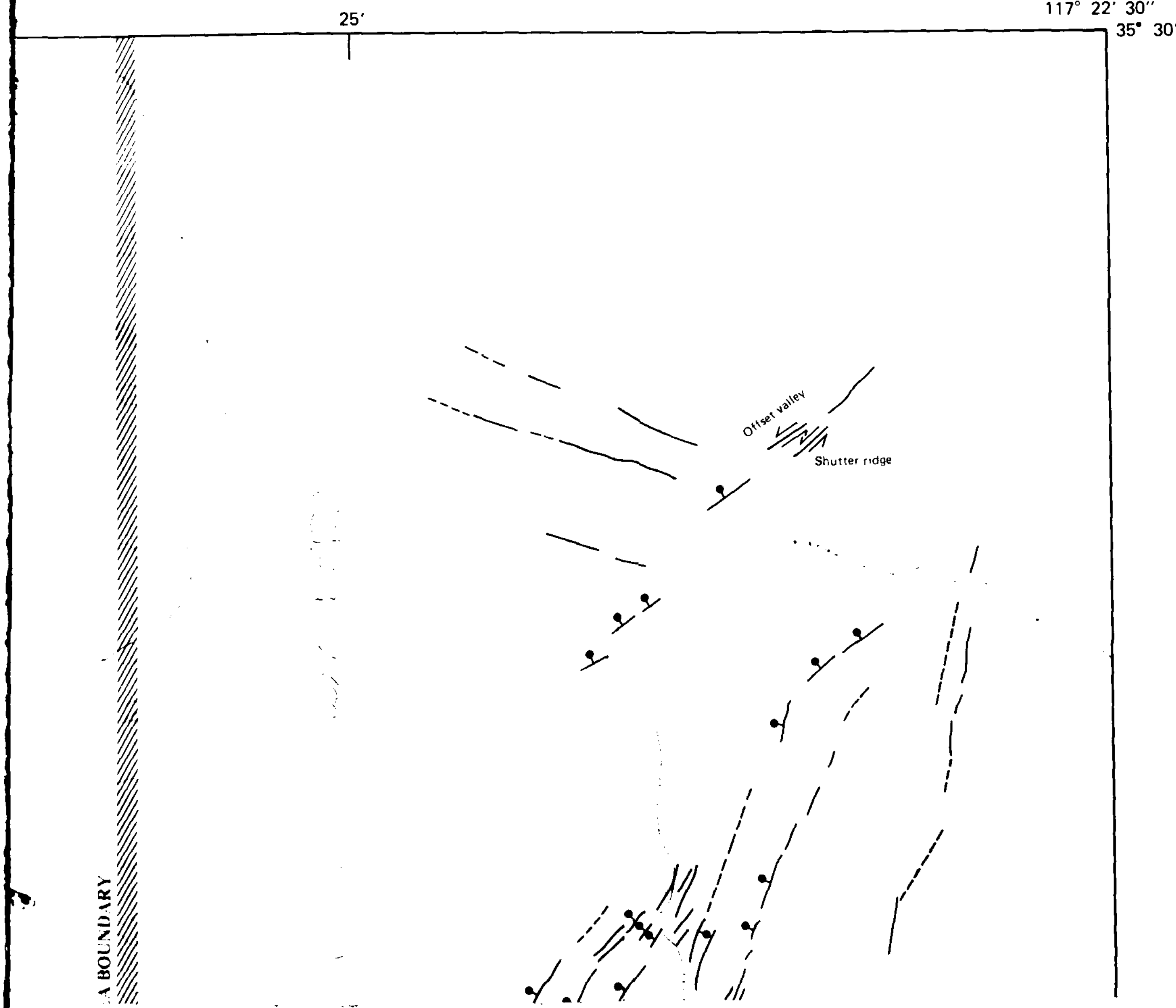
BY G.R. ROQUEMORE,
P.E. SMITH, E.W. BANKS
& J.T. ZELLMER 1981



U S GOVERNMENT PRINTING OFFICE 1982 684 142


17′ 30″
35° 30′

CUDDEBACK LAKE QUADRANGLE--NW
CALIFORNIA-SAN BERNARDINO CO.



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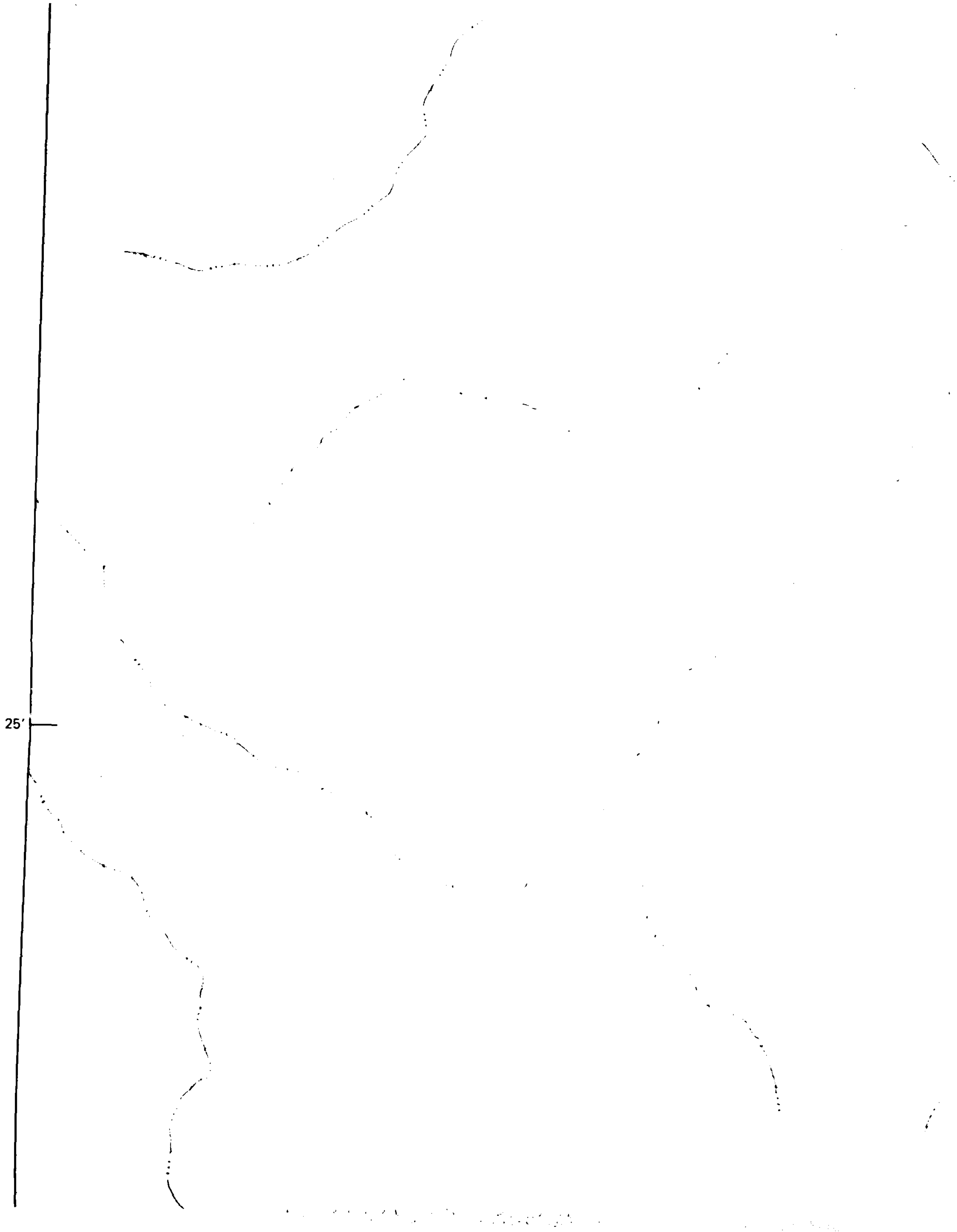
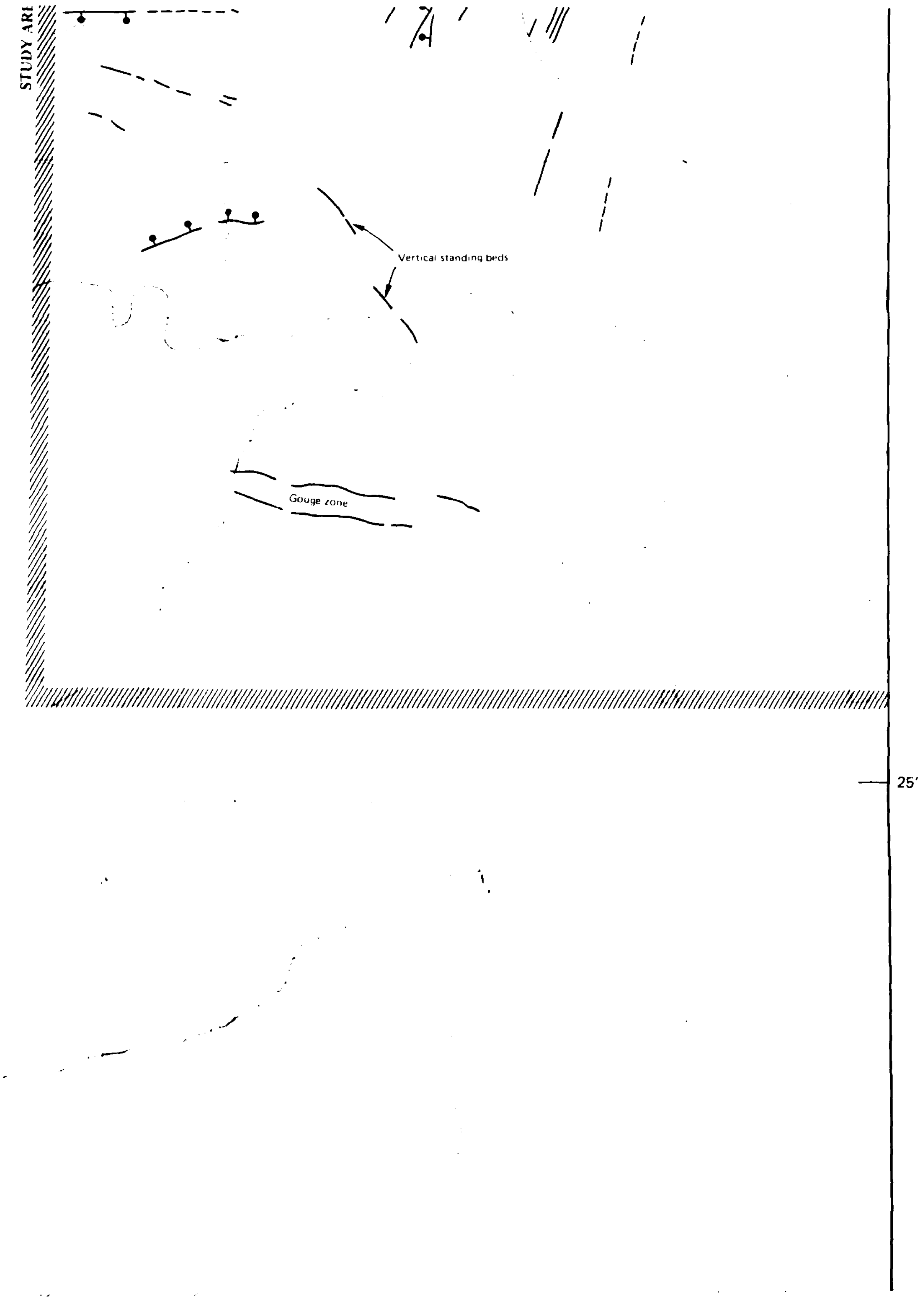

25'



FAULT MAP SERIES

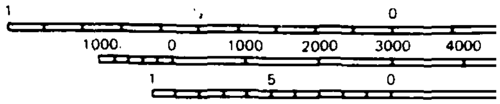
35° 22′ 30″

17′ 30″

A SCARP
B FACETED SPUR
C LINEAR TROUGH
D LINEAR VALLEY
E SHUTTER RIDGE
F NOTCH
G BENCH
H OFFSET DRAINAGE CHANNEL
I SAG POND
J DEPRESSION (PLAYA BASIN)
K PONDED ALLUVIUM
L SPRING
M OFFSET RIDGE
N LINEAR RIDGE
O HILLSIDE VALLEY

GENERALIZED DIAGRAM OF FAULT FEATURES

SCALE 1 24 000



CONTOUR INTERVALS, 40 F

DATUM IS MEAN SEA LEV

TOPOGRAPHIC BASE FROM U.S. G
SURVEY CUDDEBACK LAKE, CALI
15′ QUADRANGLE 1954

CARTOGRAPHY BY P. O'DE

EXPLANATION

Fault trace

Solid line, field or photogeologic evidence of recer scarps, trenches, sag ponds, or other surface featu scars where noted; queried line, possible recent interpretations not excluded; dashed line, probable distinctive surficial features of faulting not present active fault trace concealed by very recent alluvi regarded as approximate), ball on down thrown side of relative motion

Other recently active breaks that have not produ features may be present.

[1] The brief notes along the fault traces indicate locations where the f clear. Fault trace features are not limited to these localities but are p the mapped fault lines

Pleistocene Lake Shorelin

35° 22′ 30″

25′

117° 22′ 30″

1 MILE

6000 7000 FEET

1 KILOMETRE

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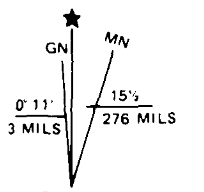
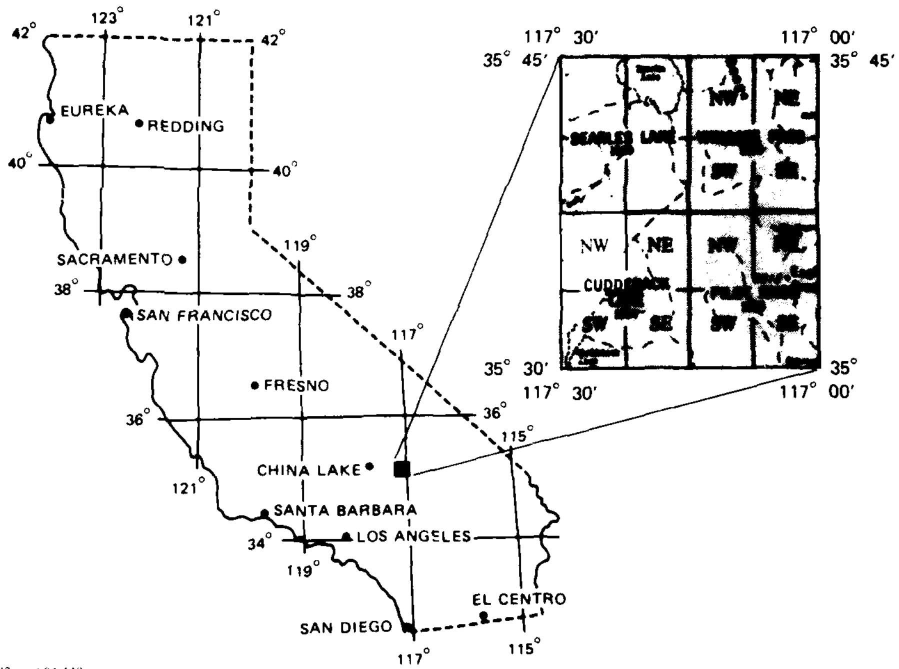


UTM GRID & 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

BY G.R. ROQUEMORE,
P.E. SMITH, E.W. BANKS
& J.T. ZELLMER 1981



...ement shown by
...luding landslide
... scarp, but other
... movement, but
... line, potentially
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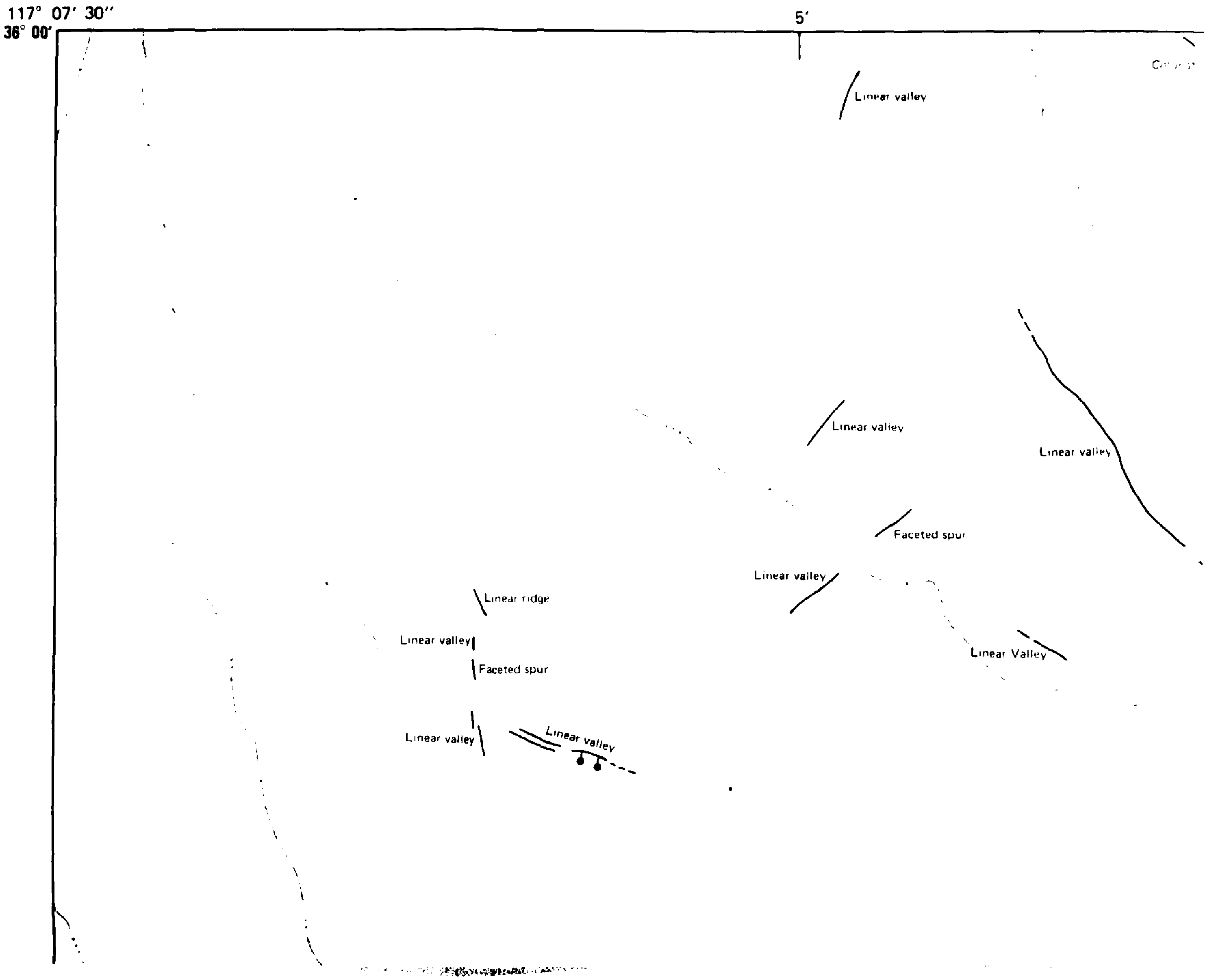
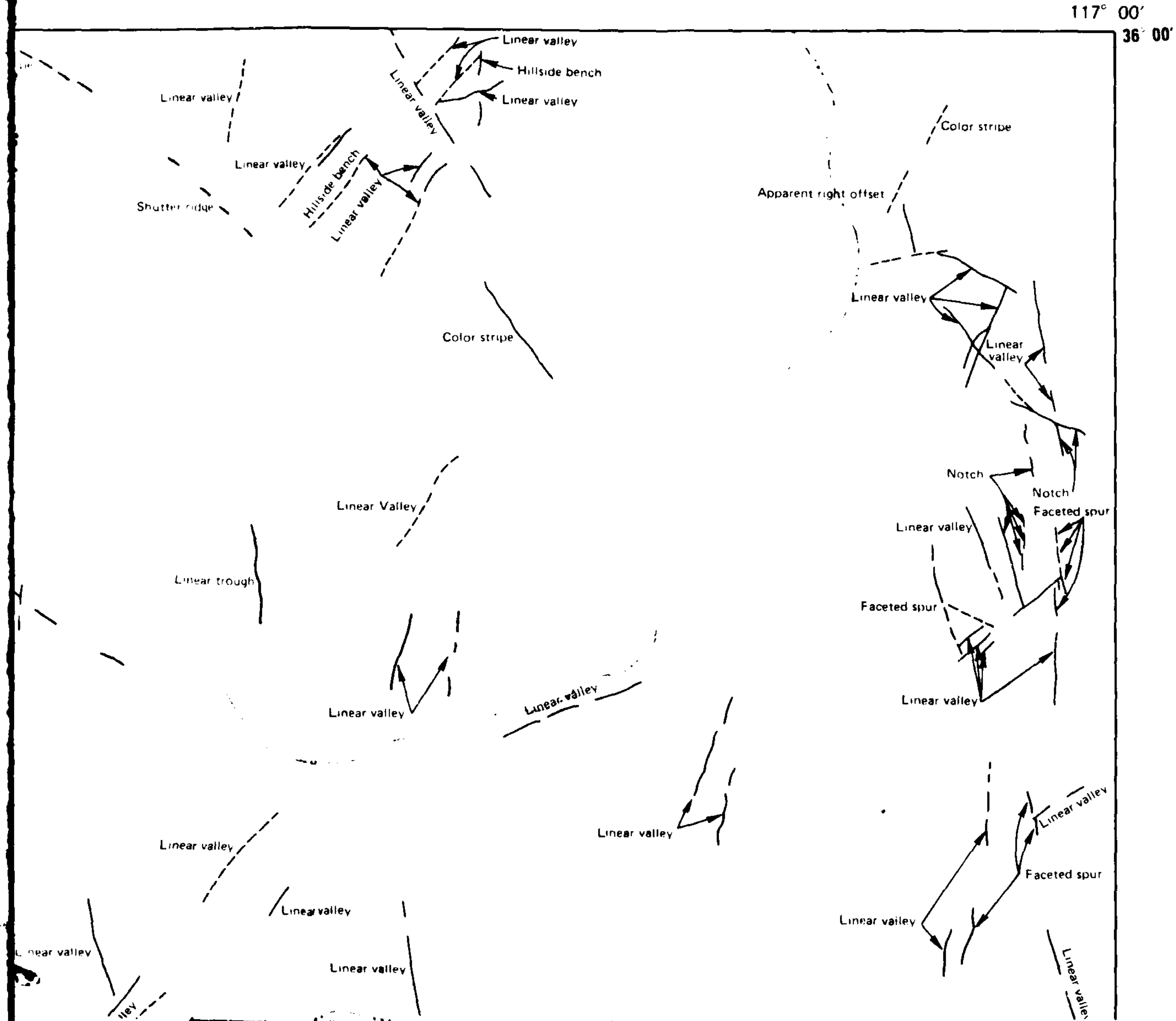
...degree all along

U.S. GOVERNMENT PRINTING OFFICE 1982 684-142



117° 07′ 30″
36° 00′
5′
Linear valley
Linear valley
Linear valley
Faceted spur
Linear valley
Linear ridge
Linear valley
Faceted spur
Linear Valley
Linear valley
Linear valley

PILOT KNOB QUADRANGLE-NE
CALIFORNIA-SAN BERNARDINO CO.



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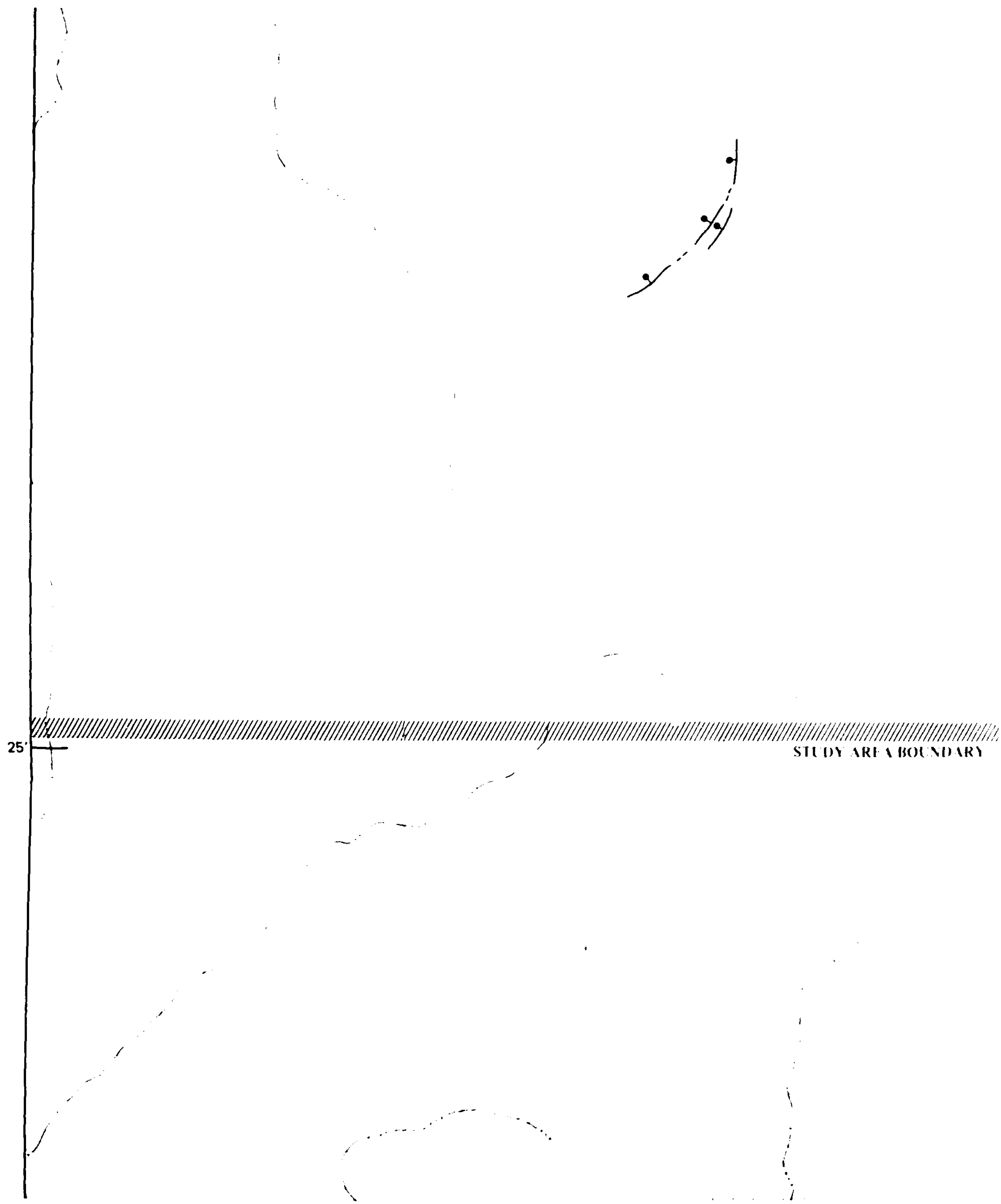
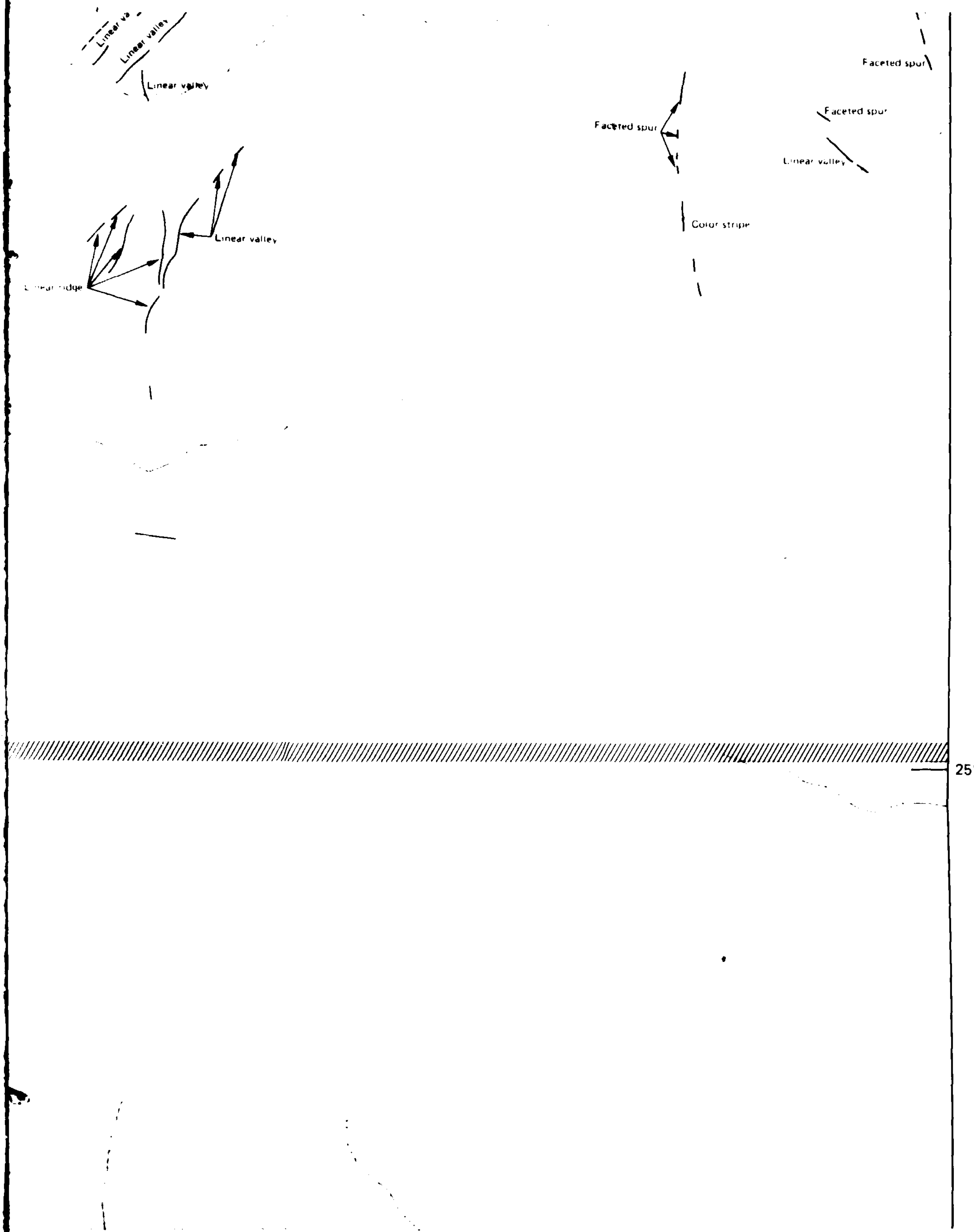

25'
STUDY AREA BOUNDARY



ACTIVE FAULT MAP SE

35° 22′ 30″
117° 07′ 30″

5′

SCALE 1 24 00

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CONTOUR INTERVALS, 4
DATUM IS MEAN SEA L

TOPOGRAPHIC BASE FROM U.S
SURVEY PILOT KNOB, CALIFO
15′ QUADRANGLE 1954

CARTOGRAPHY BY P O'

GENERALIZED DIAGRAM OF FAULT FEATURES

A SCARP
B FACETED SPUR
C LINEAR TROUGH
D LINEAR VALLEY
E SHUTTER RIDGE
F NOTCH
G BENCH
H OFFSET DRAINAGE CHANNEL
I SAG POND
J DEPRESSION (PLAYA BASIN)
K PONDED ALLUVIUM
L SPRING
M OFFSET RIDGE
N LINEAR RIDGE
O HILLSIDE VALLEY

EXPLANATIO

?

Fault trace

Solid line field or photogeologic evidence of scarps trenches sag ponds or other surface scars where noted queried line possible interpretations not excluded dashed line distinctive surficial features of faulting not pres active fault trace concealed by very recent regarded as approximate) ball on down thrown of relative motion

Other recently active breaks that have not features may be present

Pleistocene Lake Sho

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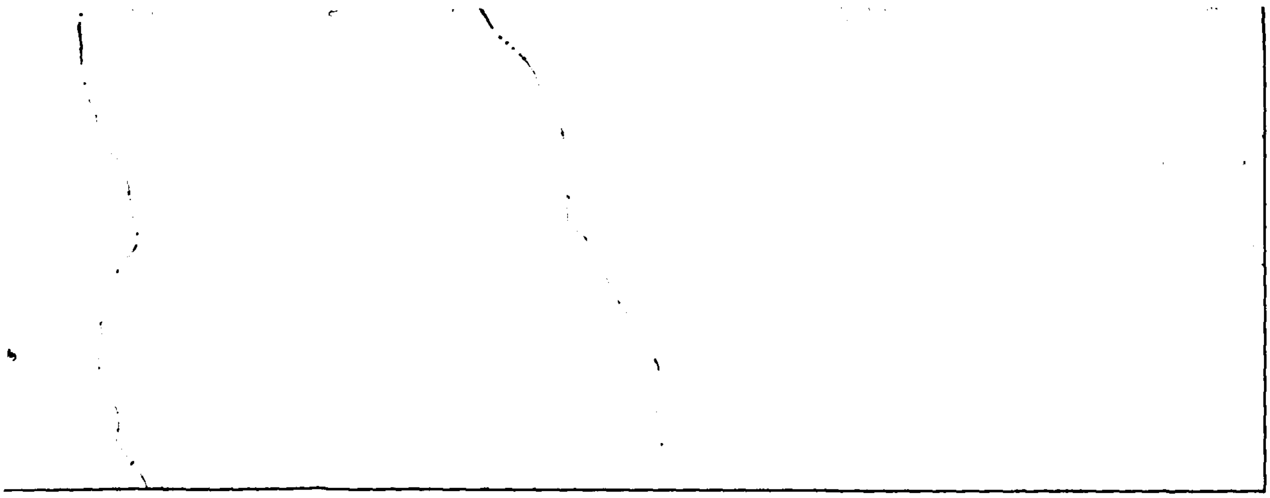
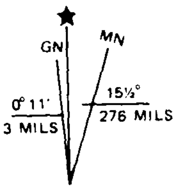


35° 22′ 30″
117° 00′

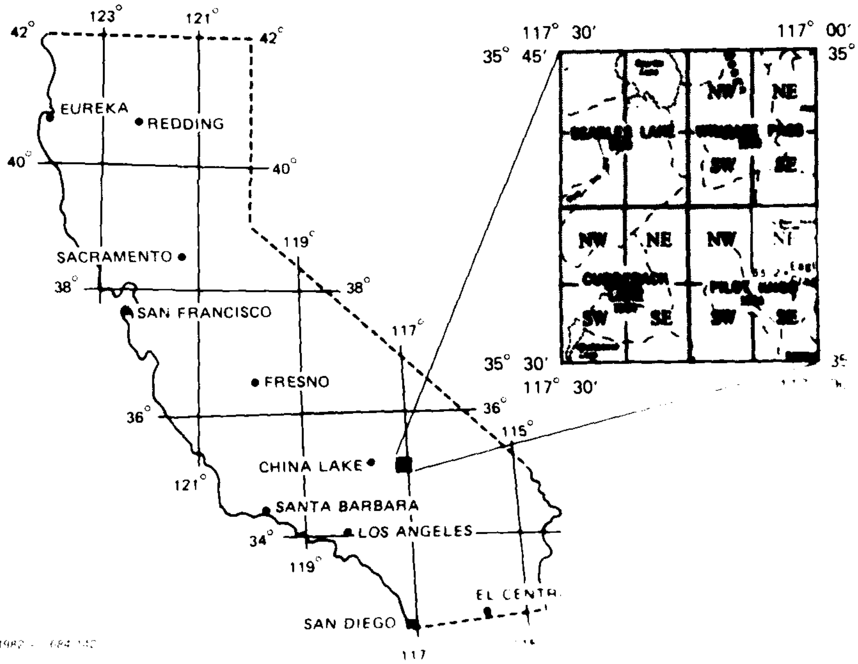
BY G.R. ROQUEMORE,
P.E. SMITH, E.W. BANKS
& J.T. ZELLMER 1981

1 MILE
6000 7000 FEET
1 KILOMETRE

ET
EOLOGICAL



UTM GRID & 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET



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AD-A188 425 NAVAL WEAPONS CENTER ACTIVE FAULT MAP SERIES(U) NAVAL WEAPONS CENTER CHINA LAKE CA G R ROQUEMORE ET AL. 31 AUG 87 NWC-TP-6828 2/2

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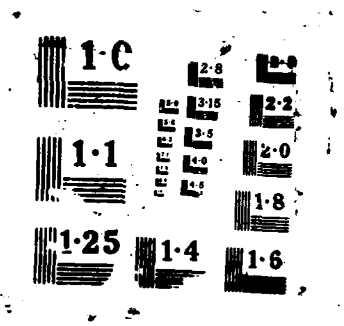
1.0
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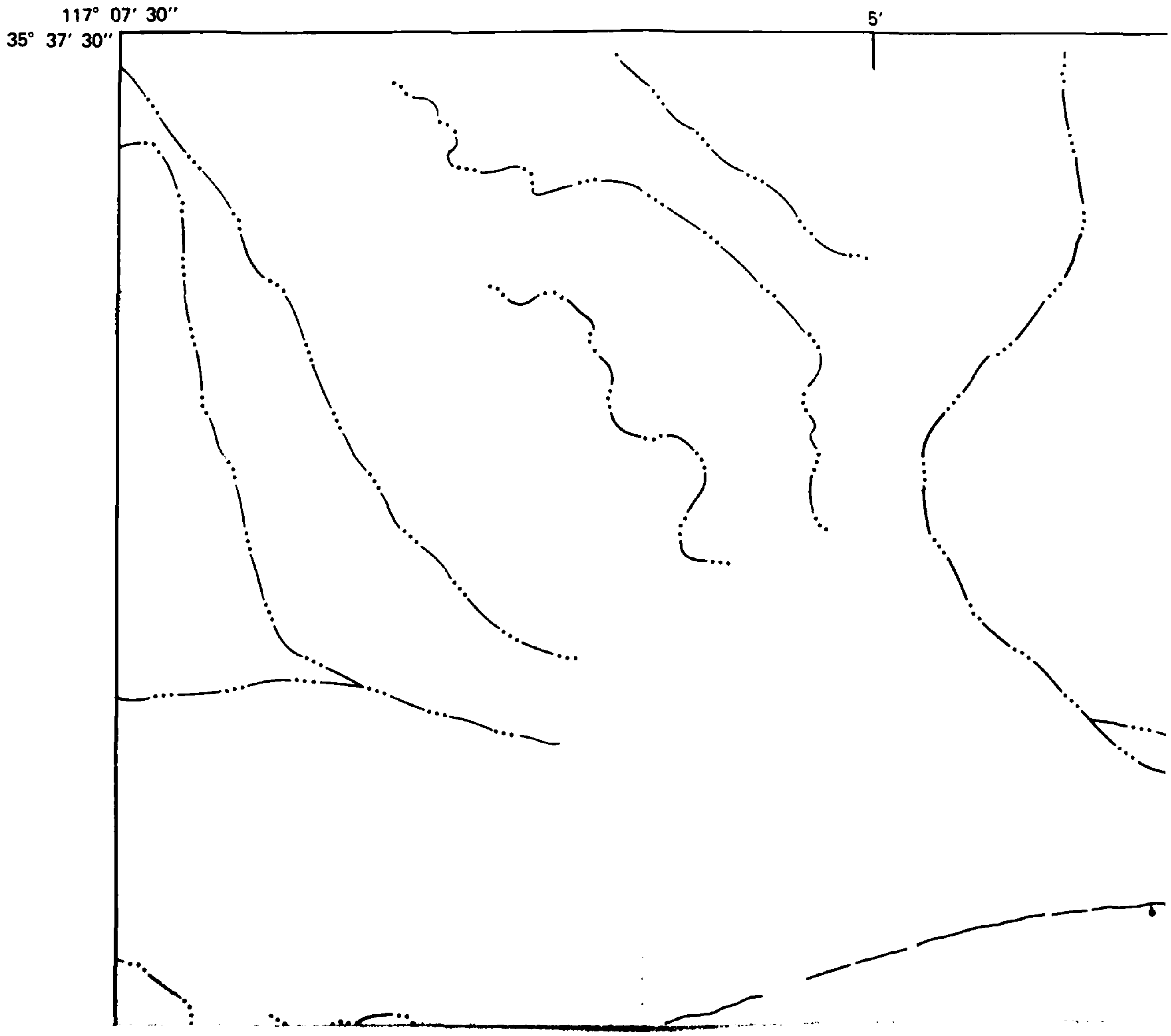
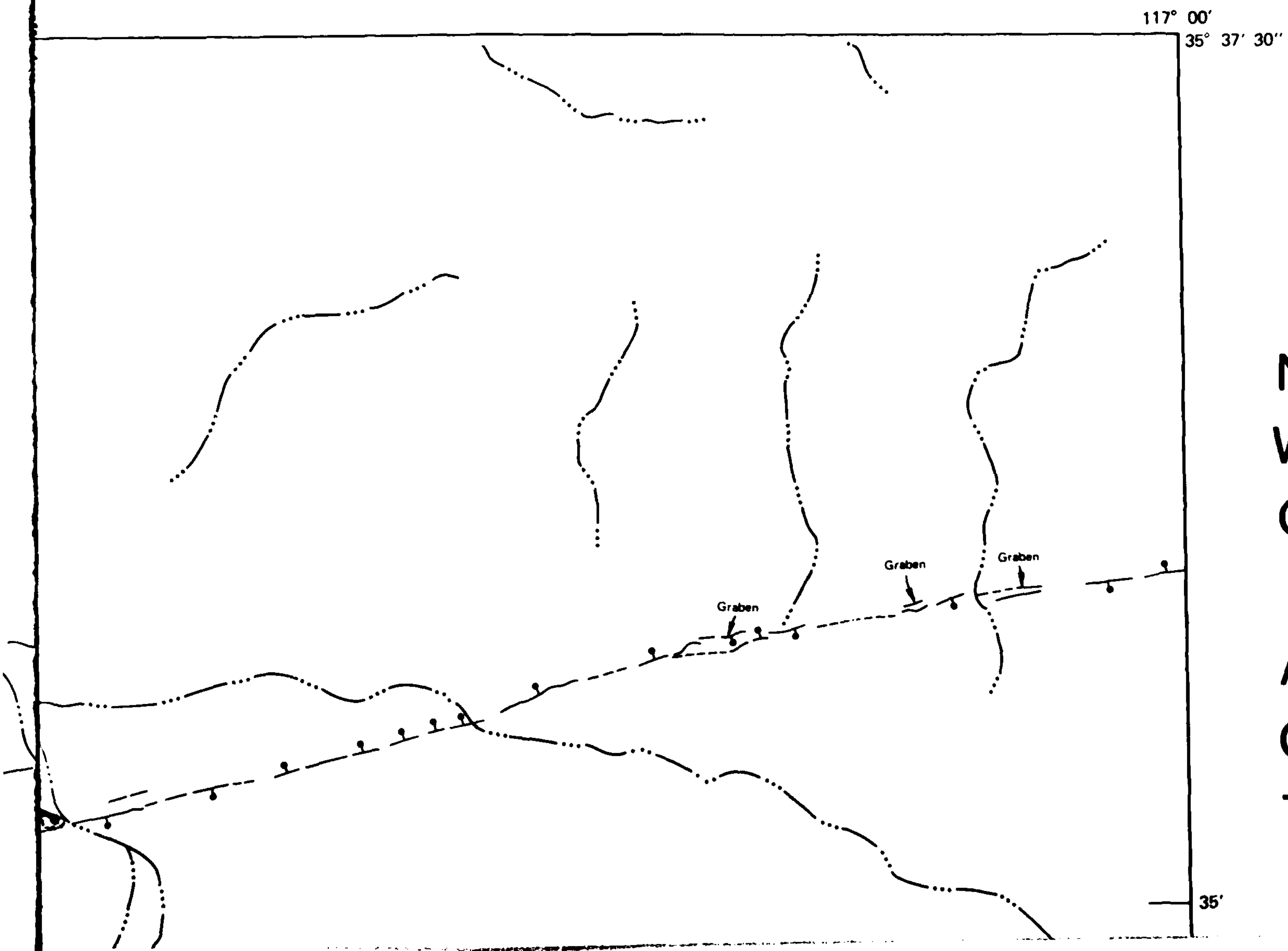

117° 07′ 30″
35° 37′ 30″
5′

WINDGATE QUADRANGLE–SE
CALIFORNIA–SAN BERNARDINO CO.



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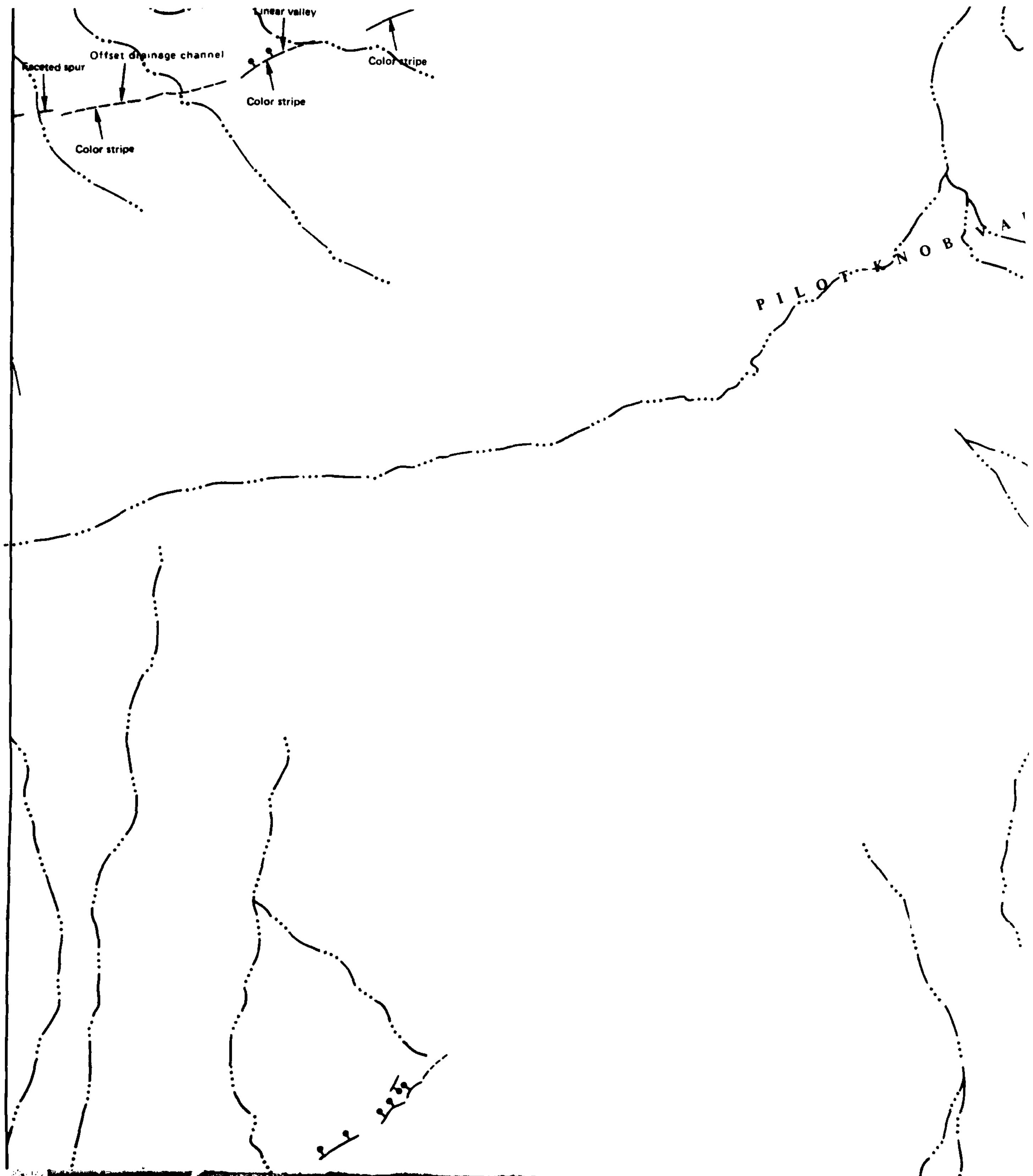
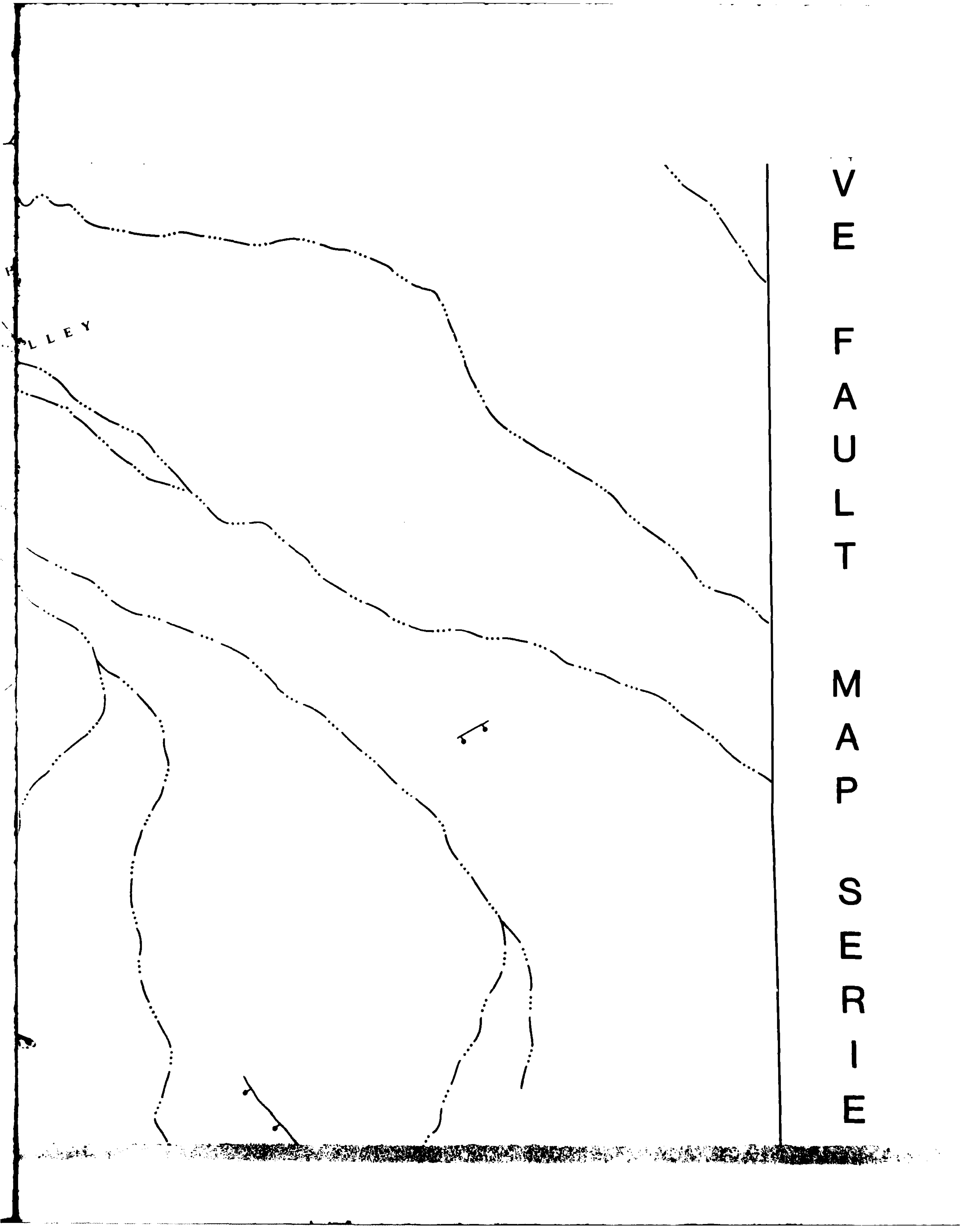
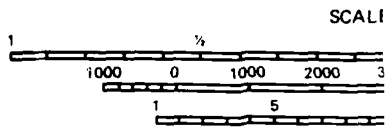

Linear valley
Offset drainage channel
Faceted spur
Color stripe
Color stripe
Color stripe
Color stripe
PILOT KNOB VA

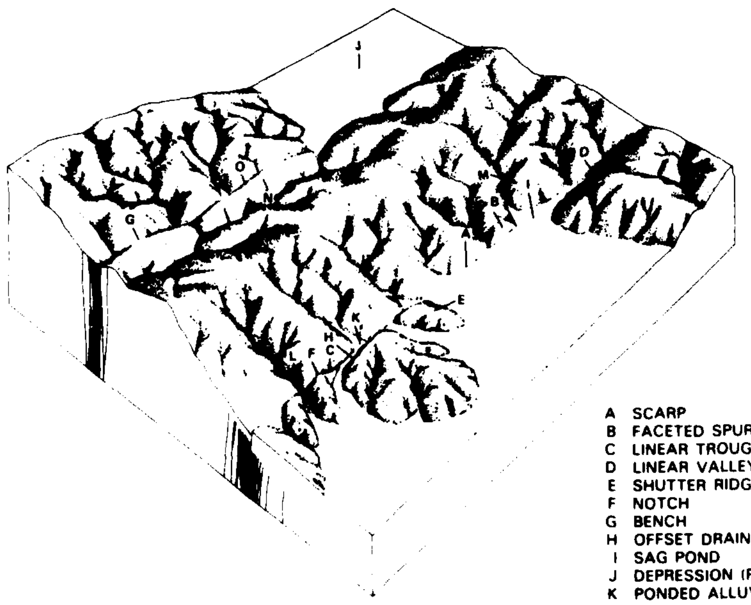

LLEY
VE FAULT MAP SERIE



CONTOUR IN
DATUM IS N

TOPOGRAPHIC BASE
SURVEY WINDGATE
15' QUADRANGLE 195

CARTOGRAPHY



A SCARP
B FACETED SPUR
C LINEAR TROUGH
D LINEAR VALLEY
E SHUTTER RIDGE
F NOTCH
G BENCH
H OFFSET DRAINAGE CHANNEL
I SAG POND
J DEPRESSION (PLAYA BASIN)
K PONDED ALLUVIUM
L SPRING
M OFFSET RIDGE
N LINEAR RIDGE
O HILLSIDE VALLEY

GENERALIZED DIAGRAM OF FAULT FEATURES

EXPLAN

Fault t

Solid line, field or photogeologic evide scarps, trenches, sag ponds, or other s scars where noted, queried line pos interpretations not excluded, dashed li distinctive surficial features of faulting active fault trace concealed by very regarded as approximatel, ball on down of relative motion

Other recently active breaks that hav features may be present

[1] The brief notes along the fault traces indicate local clear. Fault trace features are not limited to these lo the mapped fault lines

Pleistocene Lak

REFERENCES:

Clark, M. M., Map Showing Recently Active Breaks along the Garlock and Associated Faults, California. Miscellaneous Geologic Investigation Map I-741, scale 1:24 000. 1973, U.S. Geological Survey, Washington, D.C.

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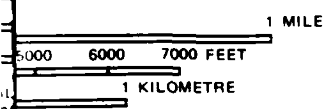
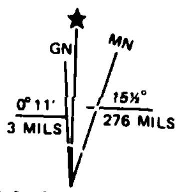
BY G.R. ROQUEMORE,
P.E. SMITH, E.W. BANKS
& J.T. ZELLMER 1981





UTM GRID & 1973 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

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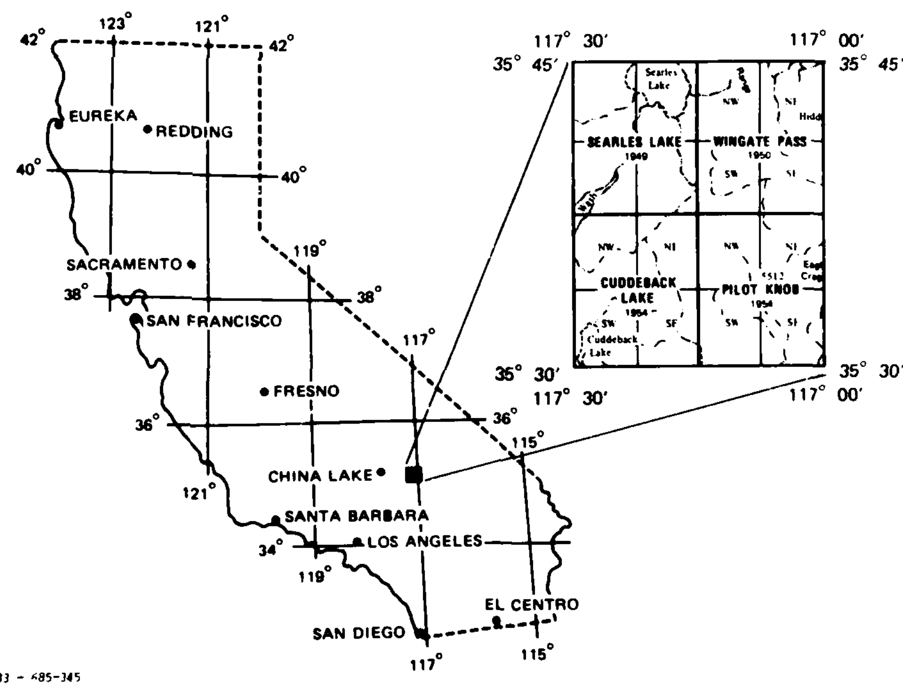

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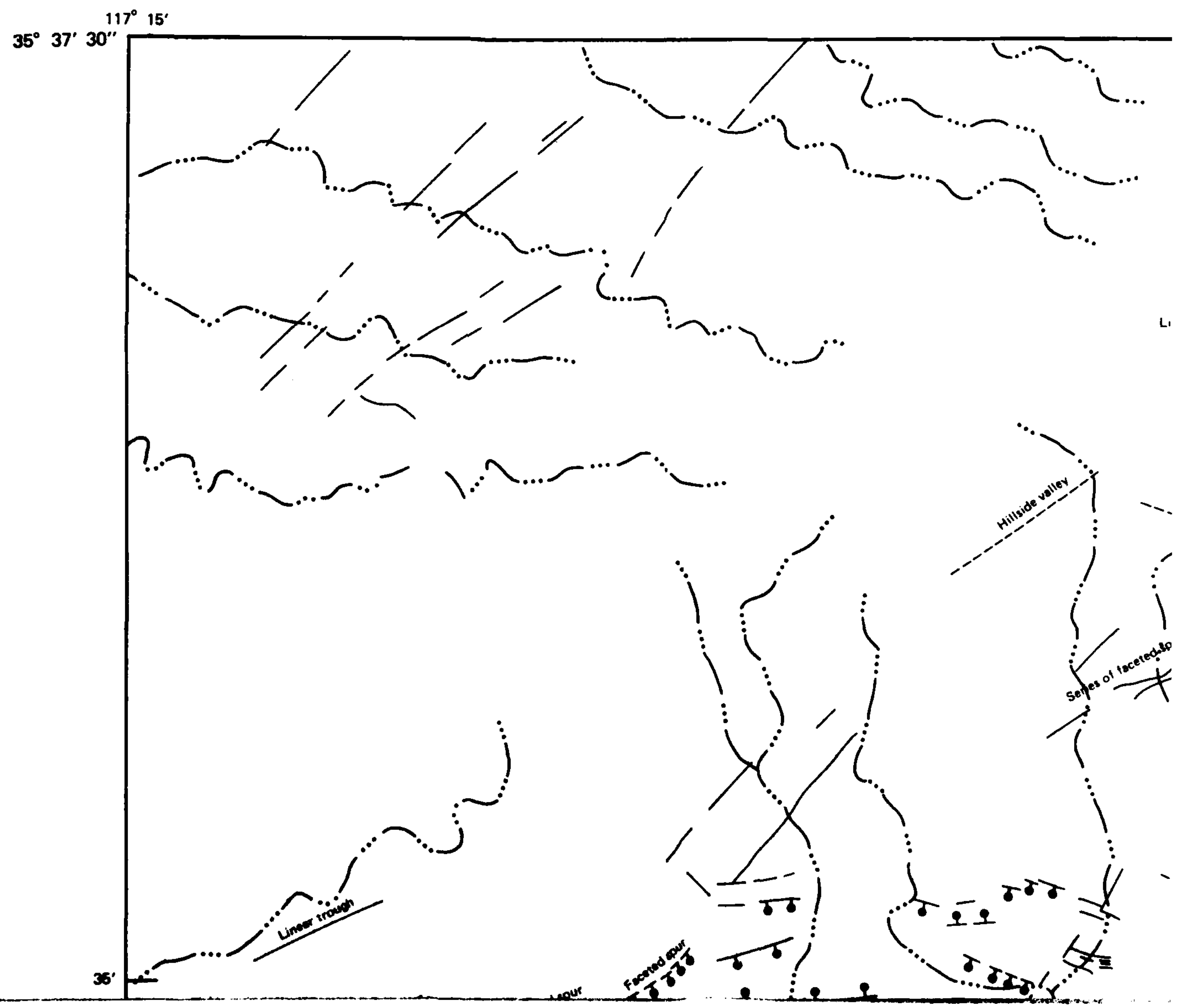
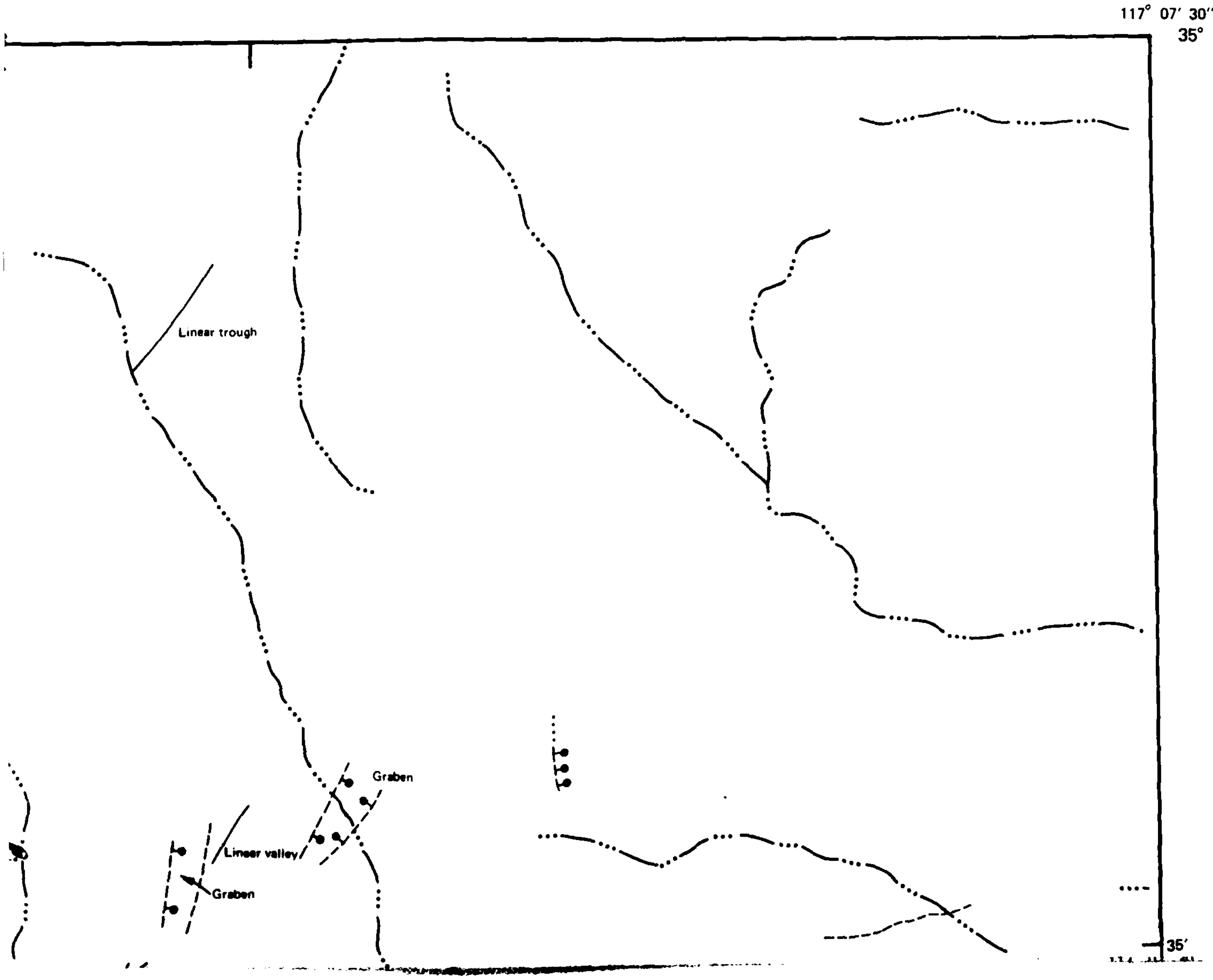
U S GOVERNMENT PRINTING OFFICE 1983 - 685-345


117° 15′
35° 37′ 30″
35′
Linear trough
Faceted spur
Hillside valley

WINDGATE QUADRANGLE–SW
CALIFORNIA–SAN BERNARDINO CO.



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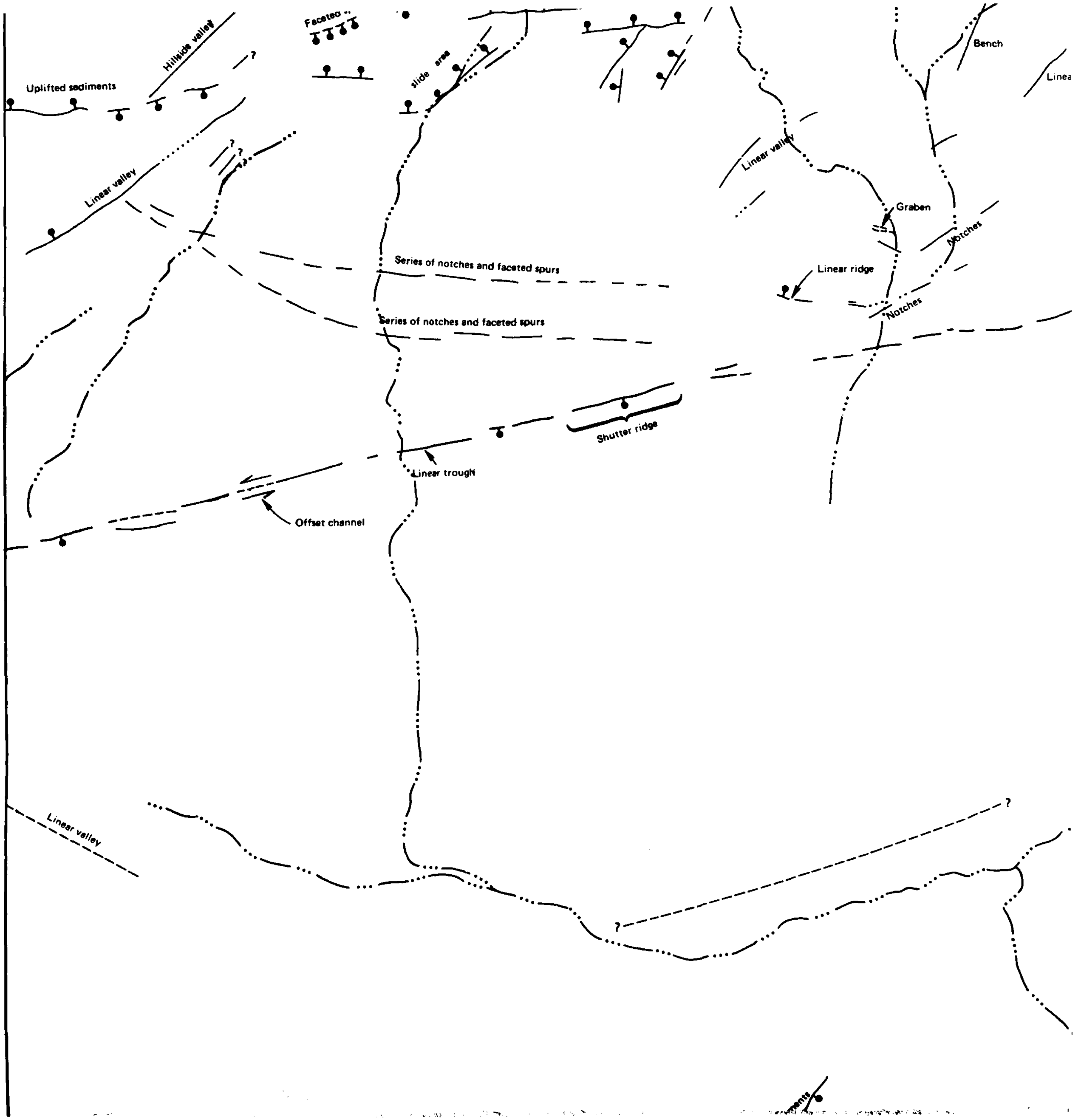
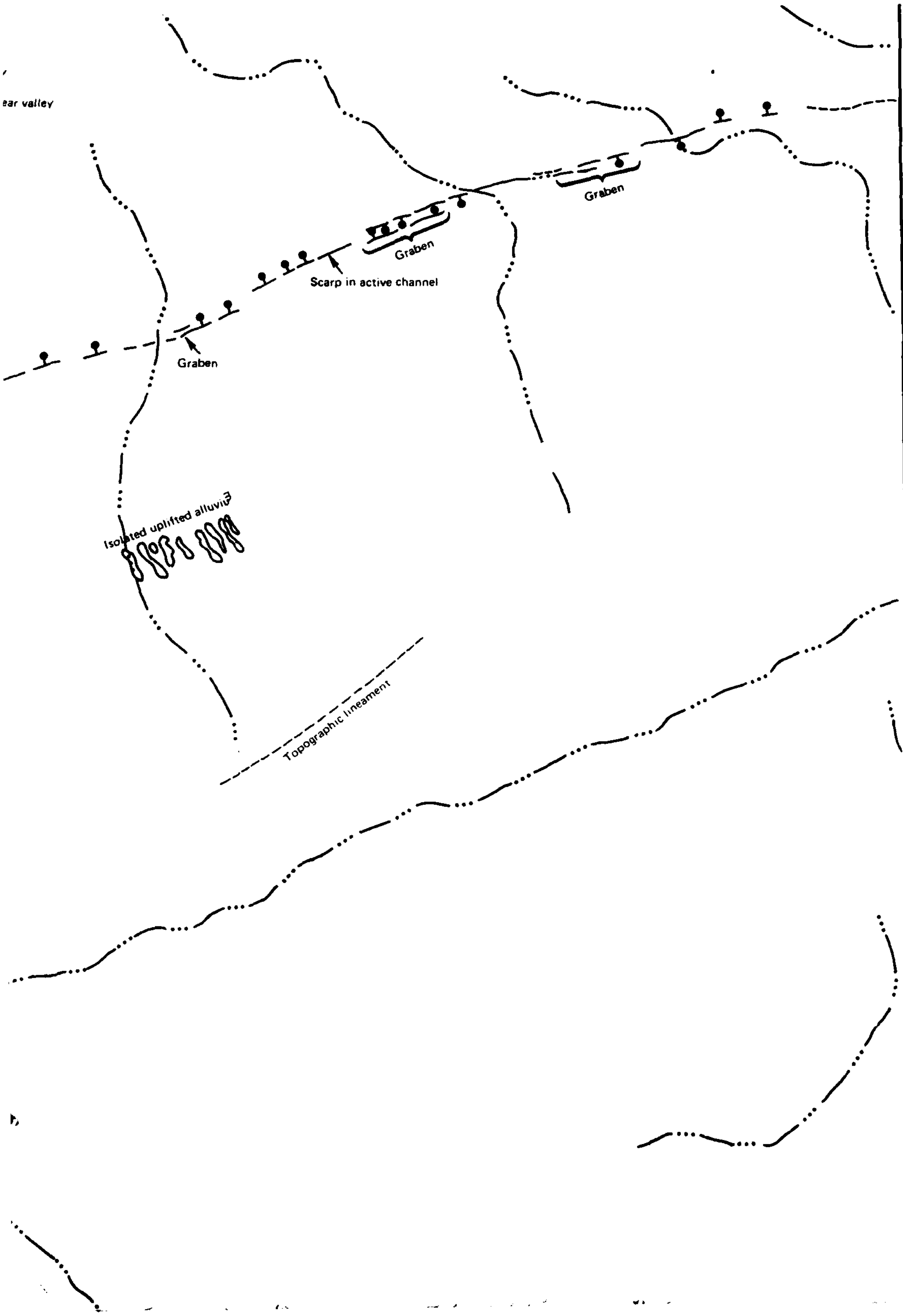
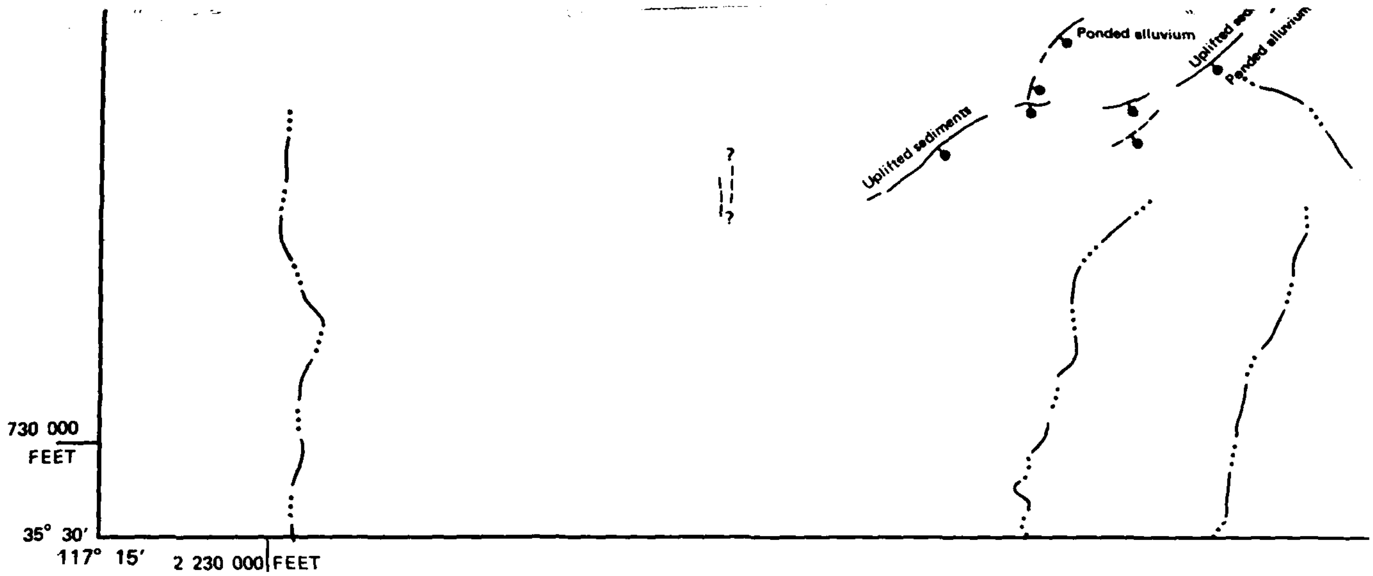

Uplifted sediments
Hillside valley
Faceted
slide area
Bench
Linear valley
Linear valley
Graben
Notches
Linear ridge
Series of notches and faceted spurs
Series of notches and faceted spurs
Notches
Shutter ridge
Linear trough
Offset channel
Linear valley



IVE FAULT MAP SERIE



SCALE 1:24 000

1 ½ 0

1000 0 1000 2000 3000 4000 50

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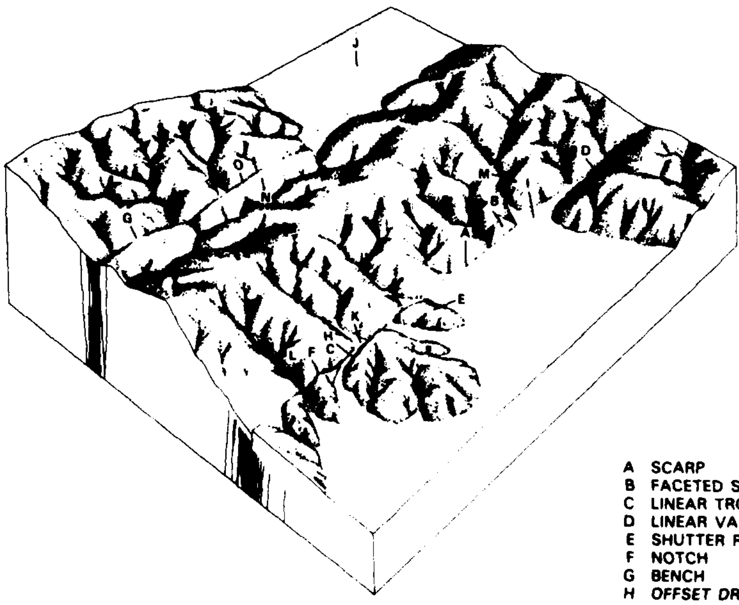
CONTOUR INTERVALS . 40 FEET
DATUM IS MEAN SEA LEVEL

TOPOGRAPHIC BASE FROM U.S. GEOL
SURVEY WINDGATE PASS, CALIFORN
15′ QUADRANGLE 1950

CARTOGRAPHY BY P. O'DELL



GENERALIZED DIAGRAM OF FAULT FEATURES

A SCARP
B FACETED SPUR
C LINEAR TROUGH
D LINEAR VALLEY
E SHUTTER RIDGE
F NOTCH
G BENCH
H *OFFSET DRAINAGE CHANNEL*
I SAG POND
J DEPRESSION (PLAYA BASIN)
K PONDED ALLUVIUM
L SPRING
M OFFSET RIDGE
N LINEAR RIDGE
O HILLSIDE VALLEY

EXPLANATION

Fault trace

Solid line, field or photogeologic evidence of recent mo
scarps, trenches, sag ponds, or other surface features,[1]
scars where noted; queried line, possible recent fault
interpretations not excluded; dashed line, probable rece
distinctive surficial features of faulting not present; dott
active fault trace concealed by very recent alluvium (p
regarded as approximate); ball on down thrown side; arro
of relative motion.

Other recently active breaks that have not produced c
features may be present.

[1] The brief notes along the fault traces indicate locations where the features
clear. Fault-trace features are not limited to these localities but are present t
the mapped fault lines.

Pleistocene Lake Shoreline

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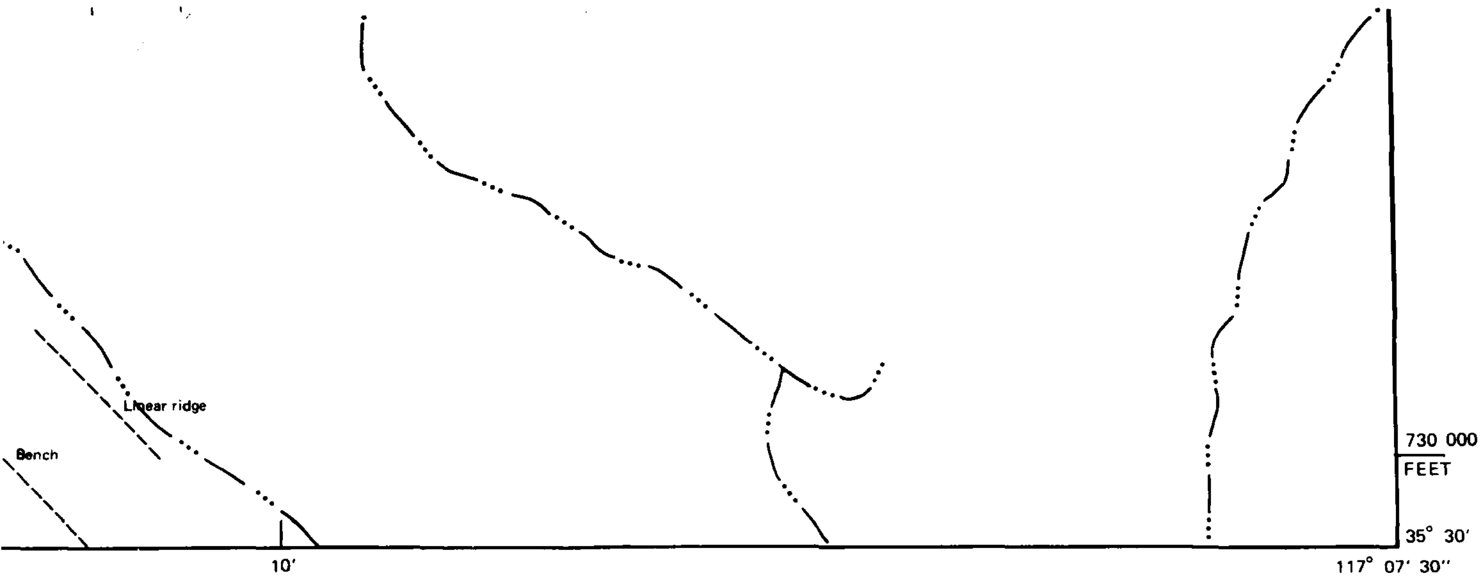
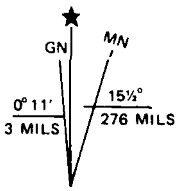


S

BY G.R. ROQUEMORE,
P.E. SMITH, E.W. BANKS
& J.T. ZELLMER 1981

1 MILE
6000 7000 FEET
1 KILOMETRE



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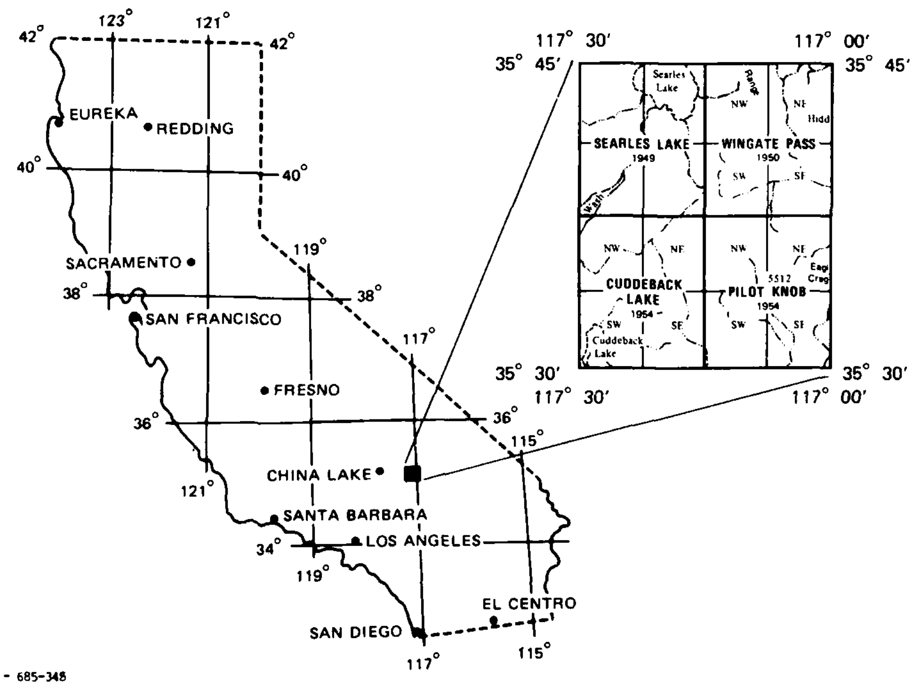

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